U. S. DEPARTMENT OF THE INTERIOR

PROTOTYPE OIL SHALE LEASING PROGRAM

TRACT C-b

QUARTERLY REPORT #3

(Through May 31, 1975)

Submitted to:

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By:

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Alluvial Well Pump Test

Lower Aquifer Pumping Test

Quarterly Report #2 contains a detailed description of the objectives and history of the upper zone phase of the aquifer pumping test at AT-1. It was stated that the upper zone test was terminated in mid-January when a drilling rig was brought back to the site, and AT-1 deepened. This action, in fact, began the preparation for testing the lower zone. The test well AT-1 was drilled to the base of the mine zone and casing was installed and cemented in place. The well was then drilled an additional 270 feet, downward into the "lower zone aquifer." A pump with water production capability of 150 gallons per minute was installed at a depth of 1430 feet below ground surface. (It was determined during the deepening of AT-1 that the lower aquifer could not sustain rates in excess of 150 gpm. The upper aquifer, by comparison, was capable of yielding greater than 400 gpm.)

Water produced during the deepening operation had a relatively low dissolved solids content, 1500 mg/l and a fluoride content of approximately 20 mg/l. This was similar in character to waters directly above the Mahogany zone in the upper aquifer. During the test, fluoride and boron levels averaged 20 mg/l and 1 to 2 mg/l, respectively. During the lower zone test, the dissolved solids content of production water never exceeded 1200 mg/l.

Background pressure readings were taken for several days before the test was actually commenced. Almost immediately, however, an equipment problem forced a restart. After restart, the test well maintained a rate of approximately 120 gpm for 17 days. At that time, the generator unit failed and the initial pumping phase of the test was terminated. A recovery period lasted for eight days and was followed by a pulse-pumping phase before final shut-in. A complete chronology of events for the lower aquifer test is given in Table II B-51.

An overview of pressure response data generated during the lower aquifer test revealed that strong anisotropic or directional permeability exists. The orientation of this anisotropy in the lower aquifer can be described as following the general direction of AT-1 to SG-6. This is approximately normal to the directional permeability shown in the upper zone test. Computer analysis has not been initiated as yet because pressure data are still being reduced and will not be available in suitable format for some time. Manual plots and interpretation of the pressure responses in the lower aquifer, however, have yielded transmissivity values as shown in Tables II B-52 and II B-53. More complete permeability values are being calculated by the Leasee's reservoir simulation group.

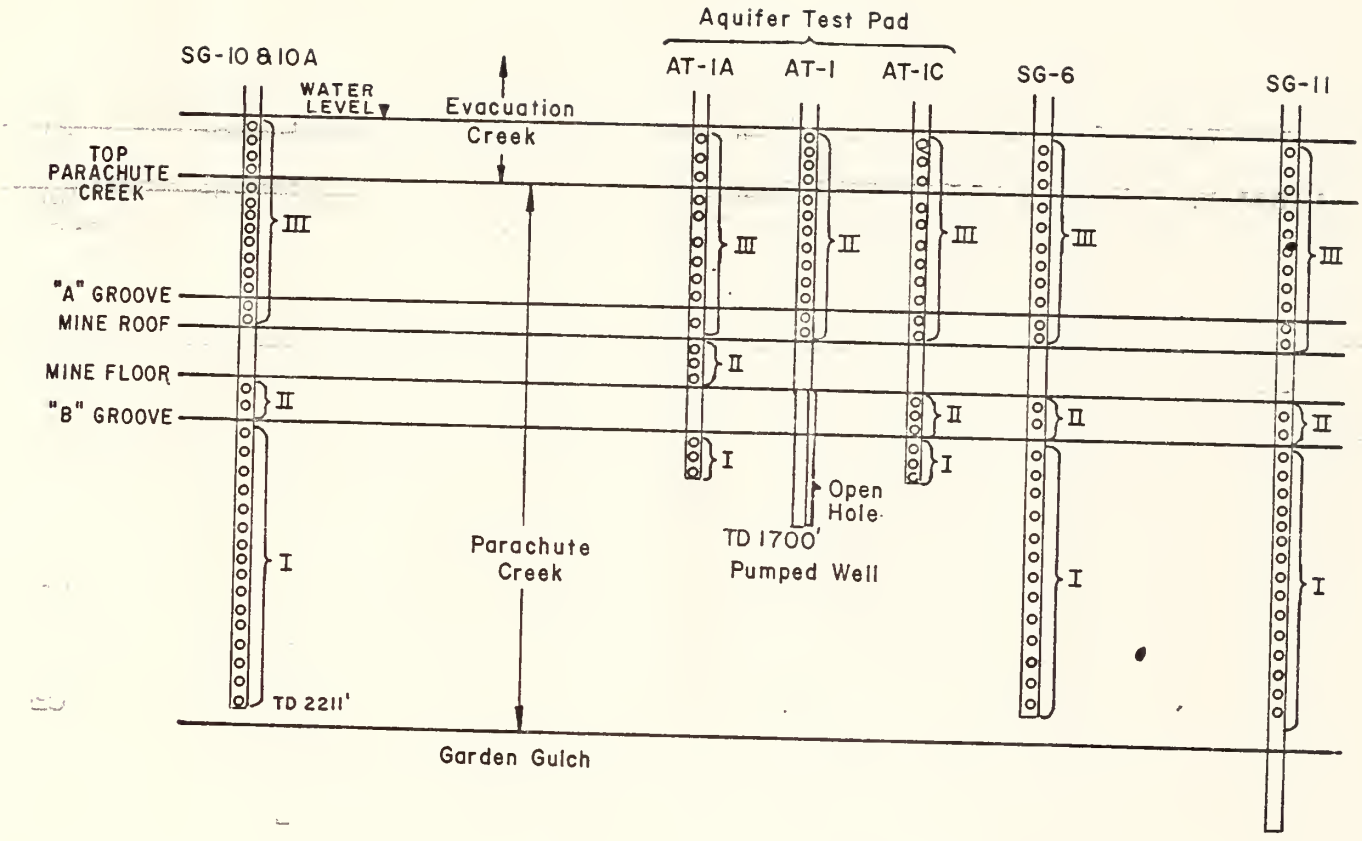


Figure
II B-14

Perforated Interval

II Tubing String Number

SCHEMATIC CROSS-SECTION
LOWER AQUIFER PUMP TEST
C-b TRACT, COLORADO

SCALE: None

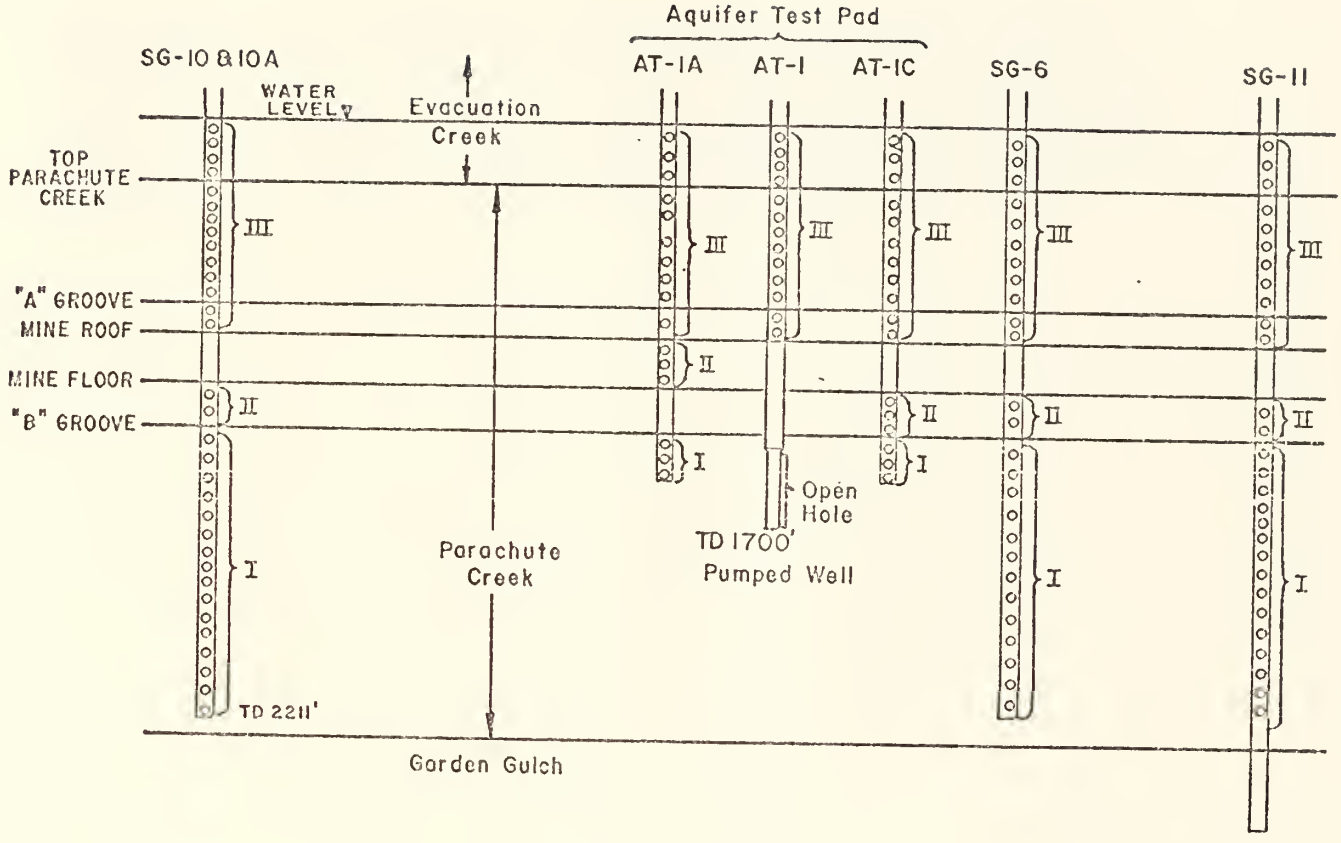


Figure II B-14

SCHEMATIC CROSS-SECTION
LOWER AQUIFER PUMP TEST
C-b TRACT, COLORADO

SCALE: None

With respect to potential aquifer interconnection, it was observed that pressure gauges in the upper zone showed no response to the pumping in the lower zone, in spite of large drawdown of lower aquifer water levels during the pumping of AT-1. Water levels in the upper aquifer continued to recover throughout the lower zone test. This is an expected response, if the two aquifer systems are hydraulically separated by the Mahogany zone; water levels in the upper zone would be expected to recover or rise as a response to the termination of pumping of the upper aquifer.

Supplemental graphs have been provided which illustrate the manual data interpretation conducted to date (Pages II B-1088 through II B-1157). Pressure (psi) is plotted versus time for each of the well strings monitored during the lower zone tests. Additional data in the form of computer reduced water level responses and pressure responses is currently being generated and is not available for reporting.

TABLE II B-51
LOWER AQUIFER PUMP TEST

Sequence of Events

6-hour surge test drawdown (systems test) 2-5-75 (12 P.M.-6 P.M.)

surge test recovery 2-5-75 (6 P.M.) to 2-15-75 (5:20 P.M.)

Original start of drawdown 2-15-75 (5:20 P.M.) to 2-17-75 (12:45 P.M.)

(generator failure)

Recovery Period 2-17-75 (12:45 P.M.) to 2-21-75 (12:00 P.M.)

Initial drawdown 2-21-75 (12:00 P.M.) to 3-10-75 (10:00 A.M.)

17 days pumping

Initial recovery 3-10-75 (10:00 A.M.) to 3-18-75 (12:00 P.M.)

8 days shut in

Pulse test drawdown 3-18-75 (12:00 P.M.) to 3-26-75 (12:00 P.M.)

8 days pumping

Final recovery 3-26-75 (12:00 P.M.) to 4-15-75 (12:00 P.M.)

20 days shut in

Pulled pump and instruments 4-15-75

Set up limited data collection network in AT1-c, SG-6, SG-10, and SG-11 5-7-75 through 5-14-75 changed upper strings to Stevens digital recorders, lower and middle strings using pressure monitor on Sperry systems.

LOWER AQUIFER PUMP TEST

DRAWDOWN AND RECOVERY CURVES

TABLE II B-52

TRANSMISSIVITY AND STORAGE COEFFICIENT VALUES

LOWER AQUIFER PULSE TEST - DRAWDOWN PHASE

WELL NO.	DRAWDOWN COMPUTATIONS	Horizontal Permeability
AT-1	T = 359 gpd/ft. early stage T = 532 gpd/ft. middle stage T = 756 gpd/ft. final stage	153.5 millidarcys
AT-1A (String #1)	T = 465; S = 5x10-4	94.4 millidarcys
AT-1A (String #2)	Interpretative technique is not applicable	
AT-1C (String #1)	T = 219; S = 5x10-5 early stage Instrument drift during final stage	
AT-1C (String #2)	T = 316; S = 2x10-5 early stage T = 513; S = 6x10-7 final stage	104.2 millidarcys
AT-1D (String #2)	T = 271; S = 3x10-5 early stage T = 327; S = 7x10-7 final stage	66.4 millidarcys
SG-6 (String #1	Slight downward response	
SG-6 (String #2)	T = 442; S = 8x10-5 final stage	89.7 millidarcys
SG-10 (String #1)	T = 1468; S = 2x10-4 T - 811; S - 1x10-4	164.6 millidarcys
SG- (String #2)	No response	
SG-11 (String #1)	No response	
SG-11 (String #2)	Overall downward trend	

TABLE II B-53

TRANSMISSIVITY and STORAGE COEFFICIENT VALUES

LOWER AQUIFER PUMP TEST

Well No.	Initial Drawdown	Initial Recovery
AT #1	T = 310 g/d/ft. Initial T = 460 Secondary T = 380 Tertiary	T = 160 g/d/ft. Initial T = 320 Secondary
AT #1A (String #1)	T = 441; S = 3.11x10-4 T = 338; S = 4.56x10-4	T = 435; S = 5.64x10-4 T = 335; S = 8.11x10-4
AT #1A (String #2)	No Valid Response	No Valid Response
AT #1C (String #1)	T = 129; S = 1.52x10-4 T = 260; S = 2.24x10-5	T = 1125; S = 1.80x10-4 T = 255; S = 3.22x10-5
(String #2)	T = 173; S = 5.82x10-5 T = 275; S = 2.04x10-5 T = 376; S = 3.77x10-6	T = 157; S = 9.44x10-5 T = 340; S = 1.98x10-5
AT #1D (String #1)	T = 143; S = 1.08x10-4 T = 348; S = 8.63x10-6	T = 136; S = 1.18x10-4 T = 325; S = 2.14x10-5
SG - 6 (String #1)	T = 1430; S = 4.52x10-4 T = 620; S = 3.87x10-4	T = 2800; S = 7.38x10-4
(String #2)	T = 1520; S = 6.86x10-5 T = 574; S = 5.62x10-5 T = 305; S = 6.66x10-5	T = 400; S = 7.53x10-5
SG - 10 (String #1)	T = 490; S = 6.06x10-5	T = 950; S = 1.13x10-4 T = 846; S = 1.11x10-4
(String #2)	No Response	Very Slight Downward Response
SG - 11 (String #1)	No Response	No Response
(String #2)	T = 1065; S = 1.69x10-3	No Recovery-Downward Response

$$T_1 = \frac{264\,Q}{\Delta s}$$

$\Delta s = 315 - 227 = 88 = 203.3'$

$$= \frac{264 \times 125}{203}$$

$T_1 = 160\ g/d/ft$

$$T_2 = \frac{264\,Q}{\Delta s}$$

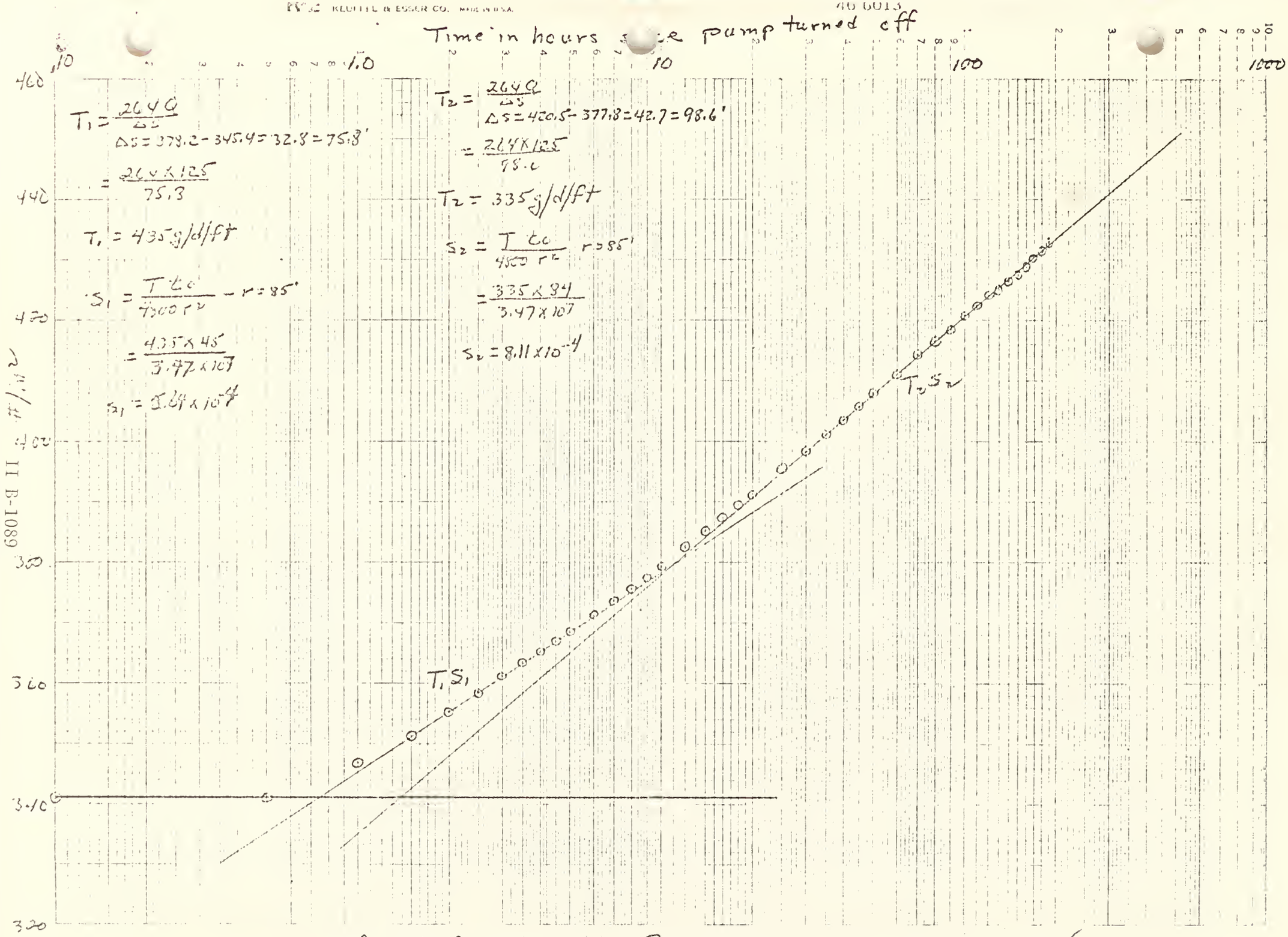
$\Delta s = 352 - 307 = 45 = 104'$

$$= \frac{264 \times 125}{104}$$

$T_2 = 320\ g/d/ft$

II B-1088

AT #1 Recovery Test 3-10-75 — 3-18-75



$T_1 = \frac{264Q}{\Delta s}$

$\Delta s = 378.2 - 345.4 = 32.8 = 75.8'$

$= \frac{264 \times 125}{75.3}$

$T_1 = 435$ g/d/ft

$S_1 = \frac{T t_o}{4800 r^2}$ — $r = 85'$

$= \frac{435 \times 45'}{3.47 \times 10^7}$

$S_1 = 5.64 \times 10^{-4}$

$T_2 = \frac{264Q}{\Delta s}$

$\Delta s = 420.5 - 377.8 = 42.7 = 98.6'$

$= \frac{264 \times 125}{78.6}$

$T_2 = 335$ g/d/ft

$S_2 = \frac{T t_o}{4800 r^2}$ $r = 85'$

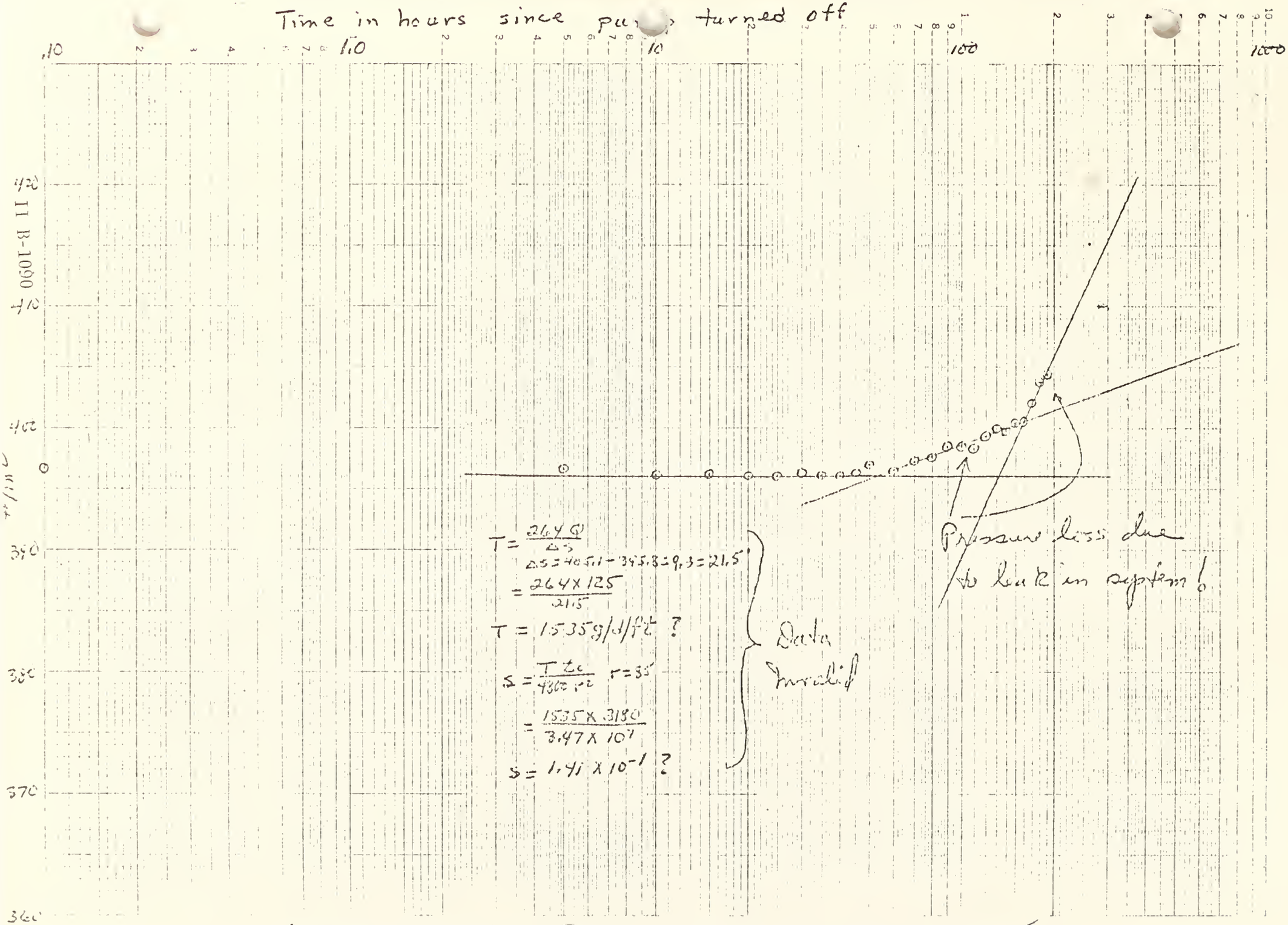
$= \frac{335 \times 84}{3.47 \times 10^7}$

$S_2 = 8.11 \times 10^{-4}$

AFB II B-1089

AT #1 A-String #1 Recovery Test 3-10-75 — 3-18-75

Time in hours since pump turned off



Pressure loss due to leak in system!

$T = \frac{264\,Q}{\Delta s}$

$\Delta s = 405.1 - 395.8 = 9.3 = 21.5'$

$= \frac{264 \times 125}{21.5}$

$T = 1535\ g/d/ft$?

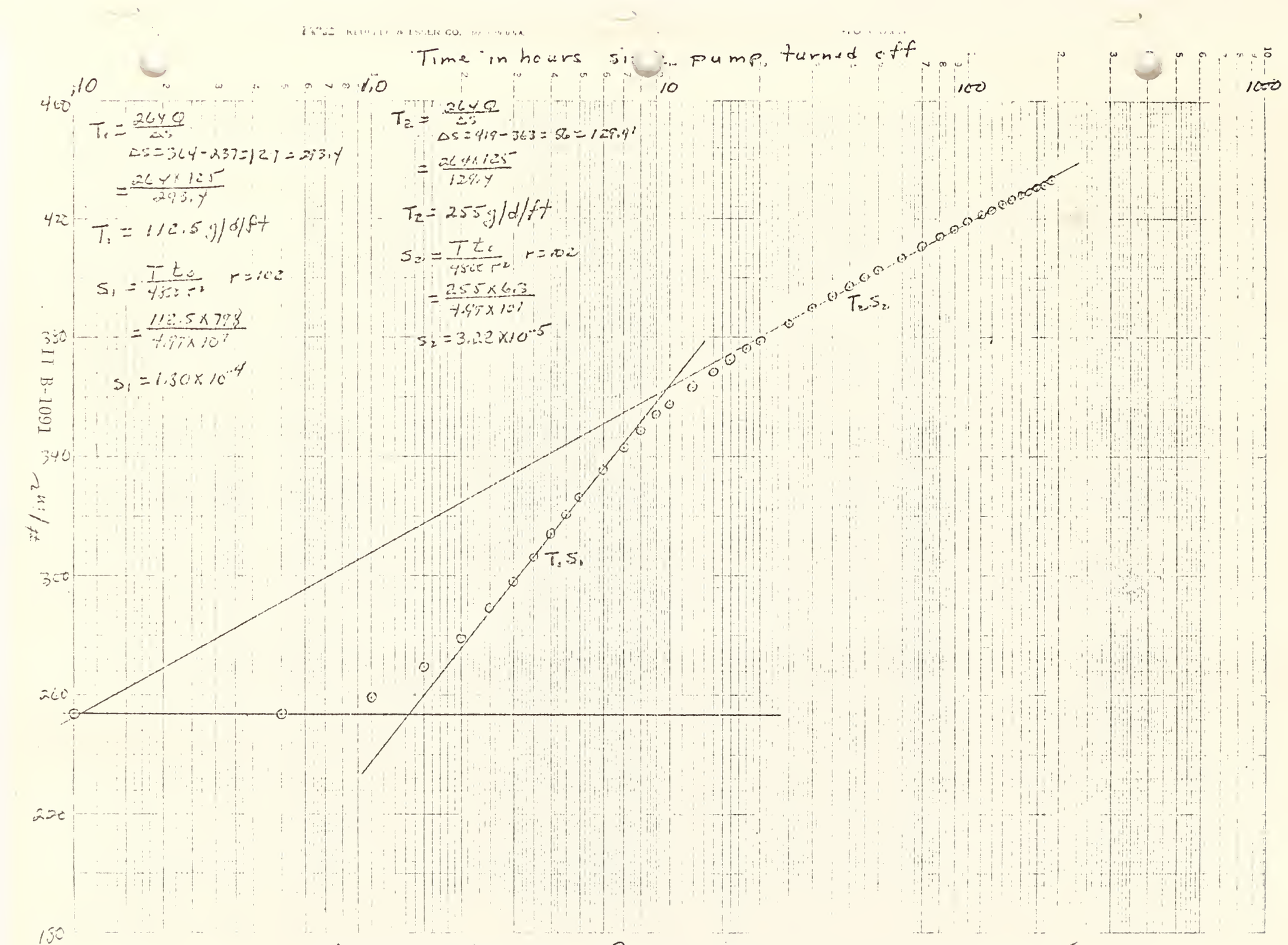
$S = \frac{T\,t_o}{480\,r^2}$ $r = 35'$

$= \frac{1535 \times 3180}{3.47 \times 10^7}$

$S = 1.41 \times 10^{-1}$?

Data Invalid

AT#1A - String #2 - Recovery Test 3-10-75 — 3-18-75



AT-1C String #1 Recovery Test 3-10-75 — 3-15-75

Time in hours since pump turned off

.10 1.0 10 100 1000

$T_1 = \frac{264\,Q}{\Delta s}$

$\Delta s = 336 - 245 = 91 = 210.2$

$= \frac{264 \times 125}{210.2}$

$T_1 = 157\ g/d/ft$

$S_1 = \frac{T \cdot t_o}{4 r^2} = 102$

$= \frac{157 \times 30}{4.44 \times 10^7}$

$S_1 = 9.44 \times 10^{-5}$

$T_2 = \frac{264\,Q}{\Delta s}$

$\Delta s = 385 - 343 = 42 = 97.0$

$= \frac{264 \times 125}{97}$

$T_2 = 340\ g/d/ft$

$S_2 = \frac{T \cdot t_o}{4 r^2}$ $r = 102$

$S_2 = \frac{340 \times 2.9}{4.44 \times 10^7}$

$S_2 = 1.98 \times 10^{-5}$

420 380 340 300 260 220

Drawdown in feet

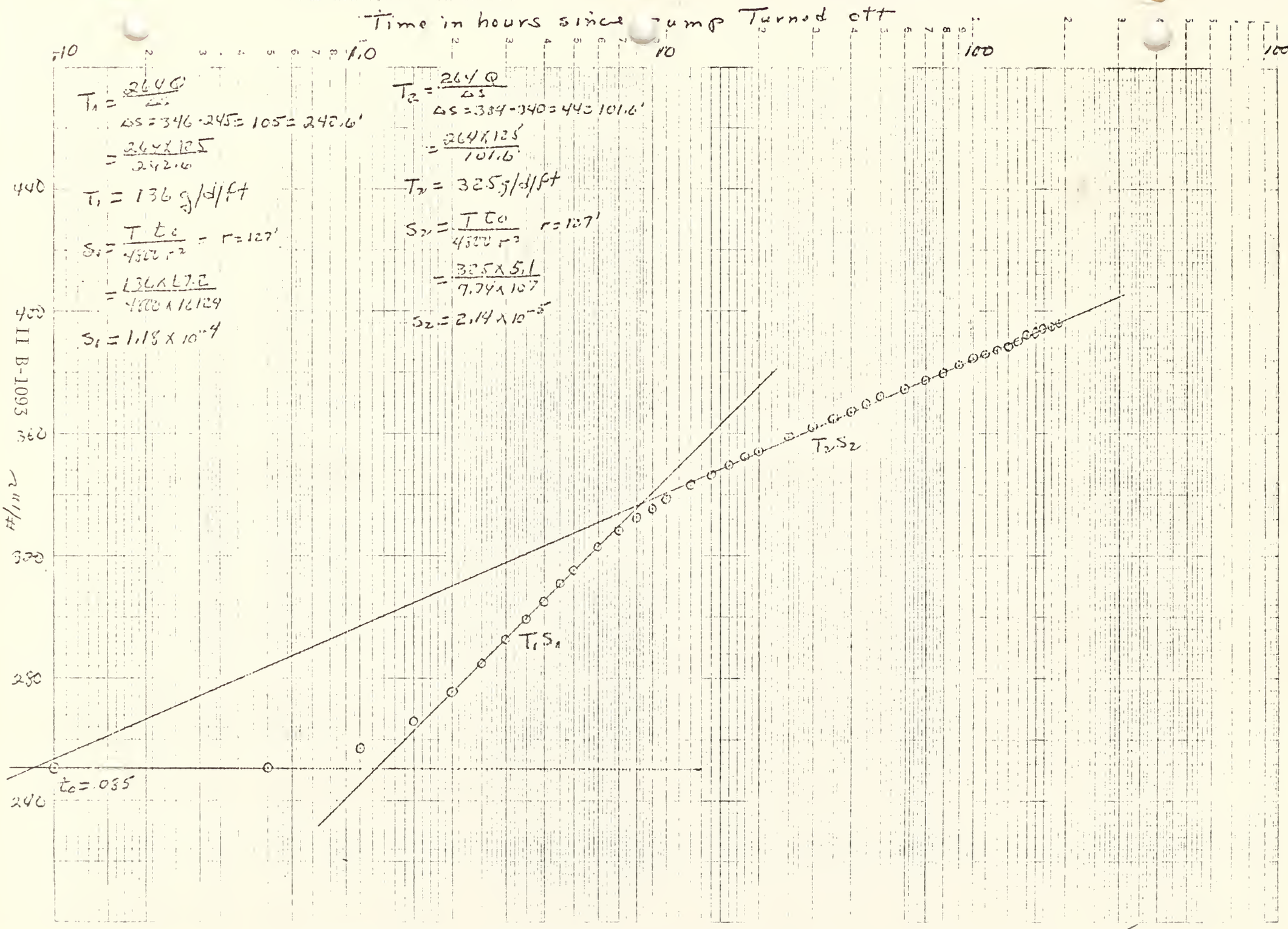
$T_2 S_2$

$T_1 S_1$

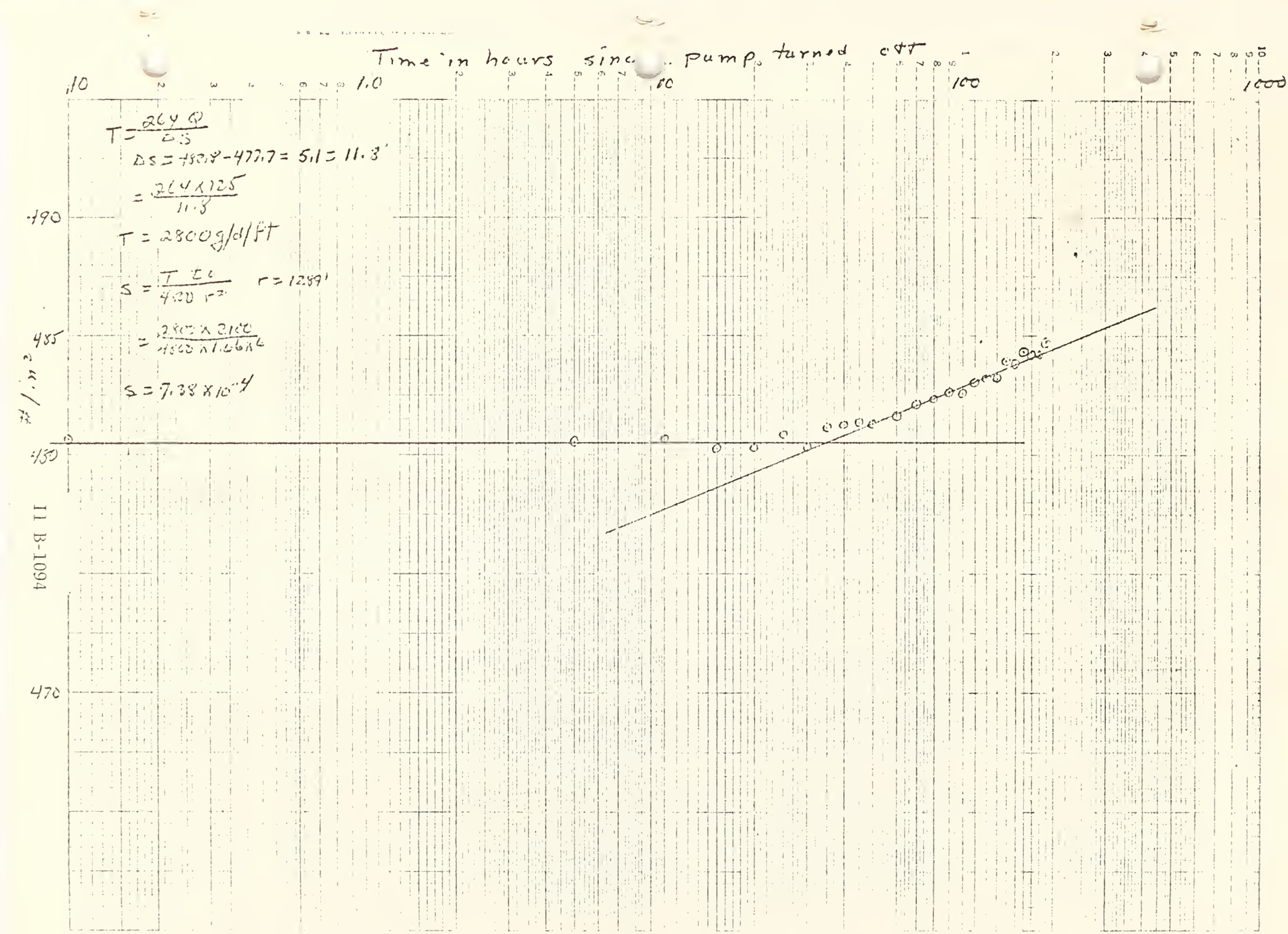
$t_o = .043$

II B-1092

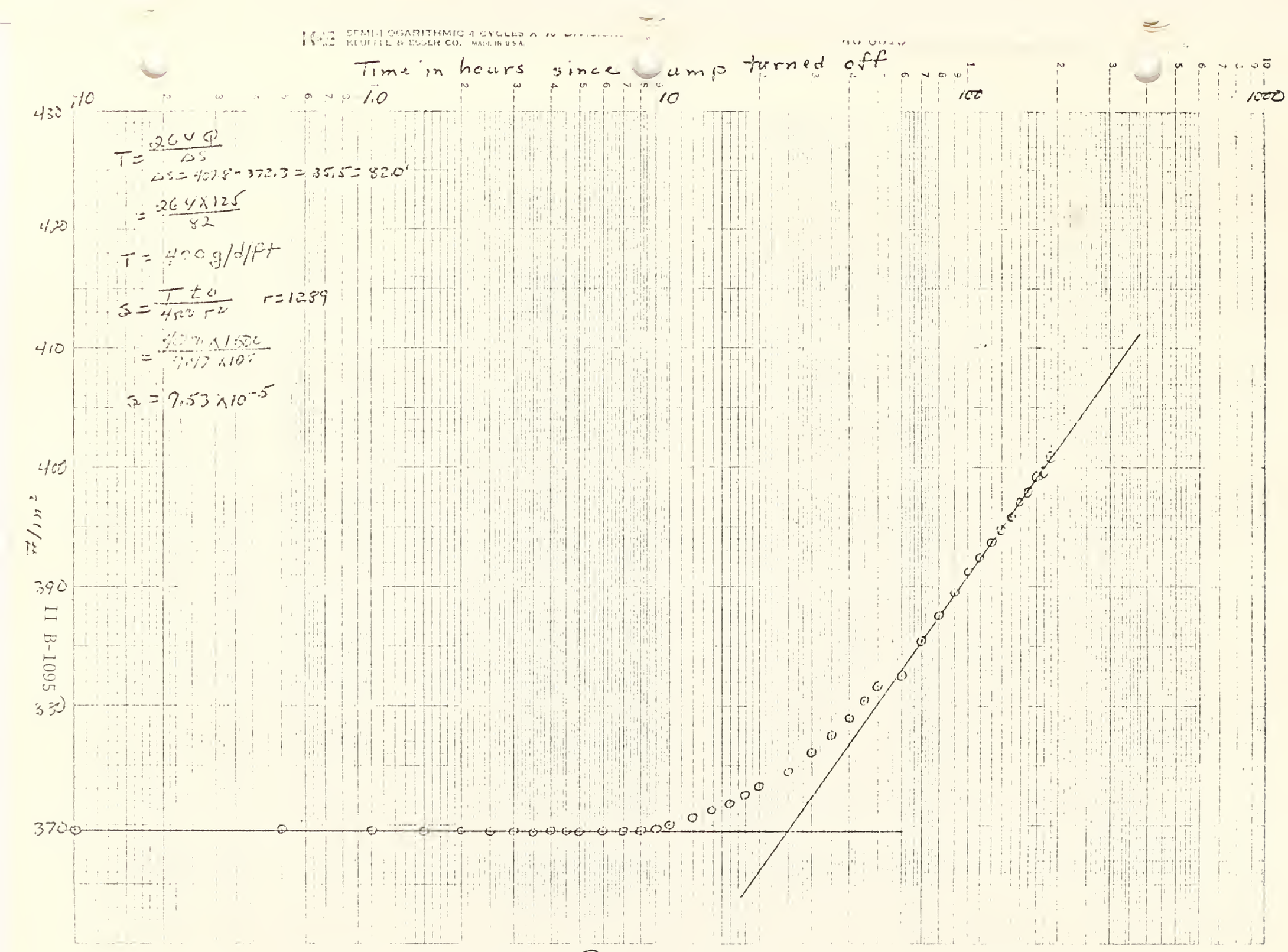
AT#1C String #2 Recovery Test 3-10-75 — 3-18-75



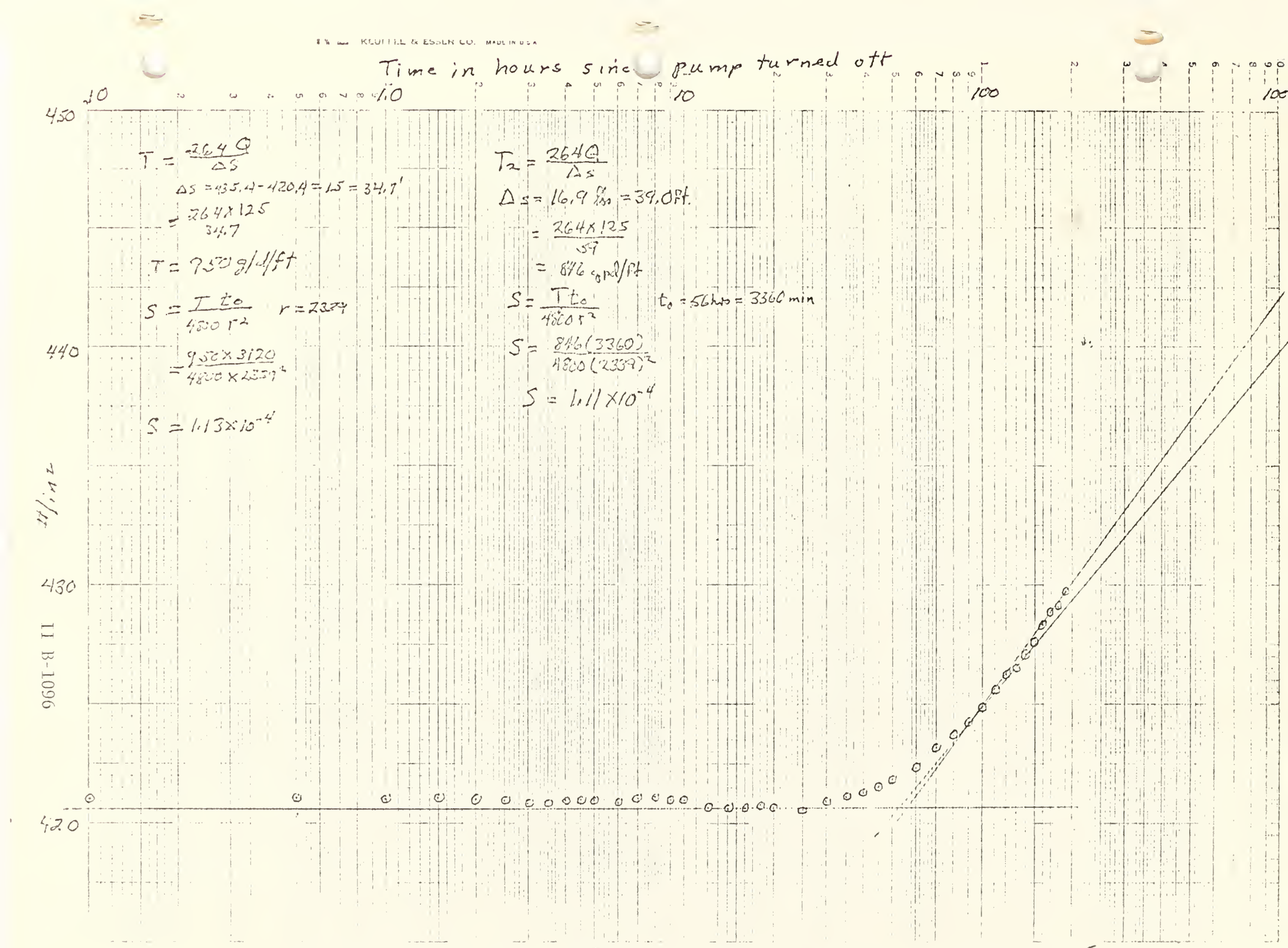
AT#1D - String #1 Recovery Test 3-10-75 — 3-18-75



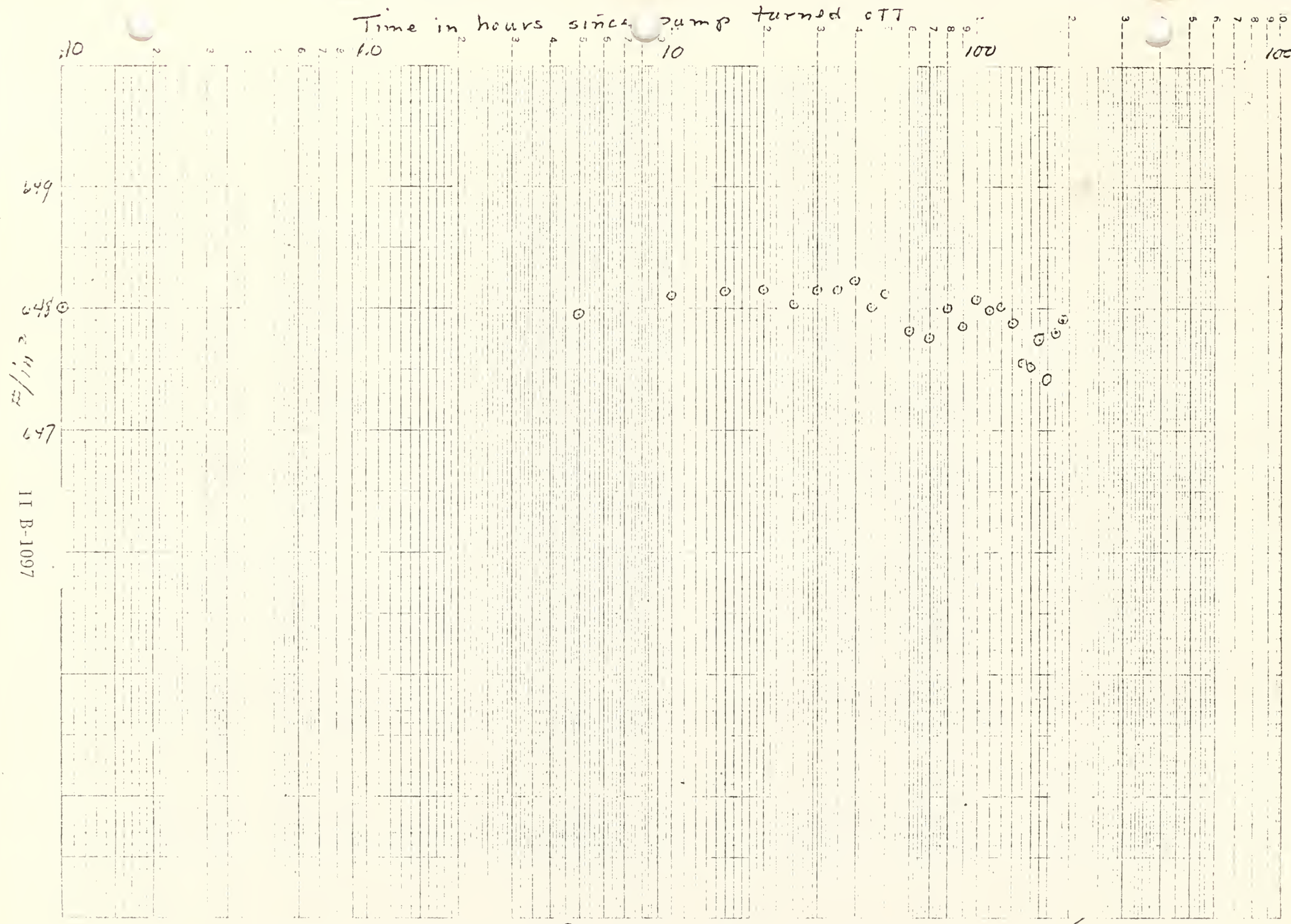
SG-6 #1 String Recovery Test 3-10-75 – 3-18-75



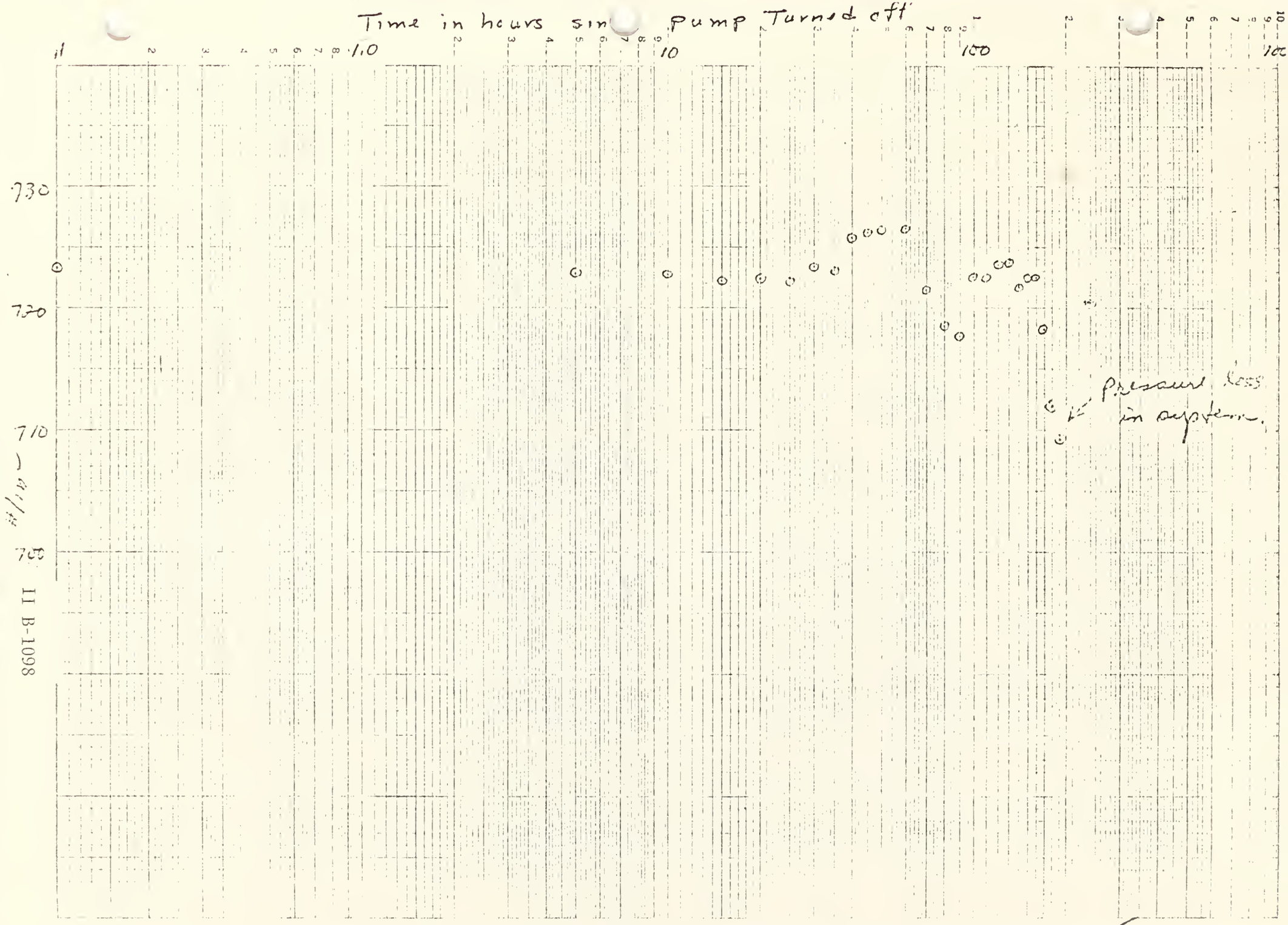
SG-6 String #2 Recovery Test 3-10-75 — 3-18-75

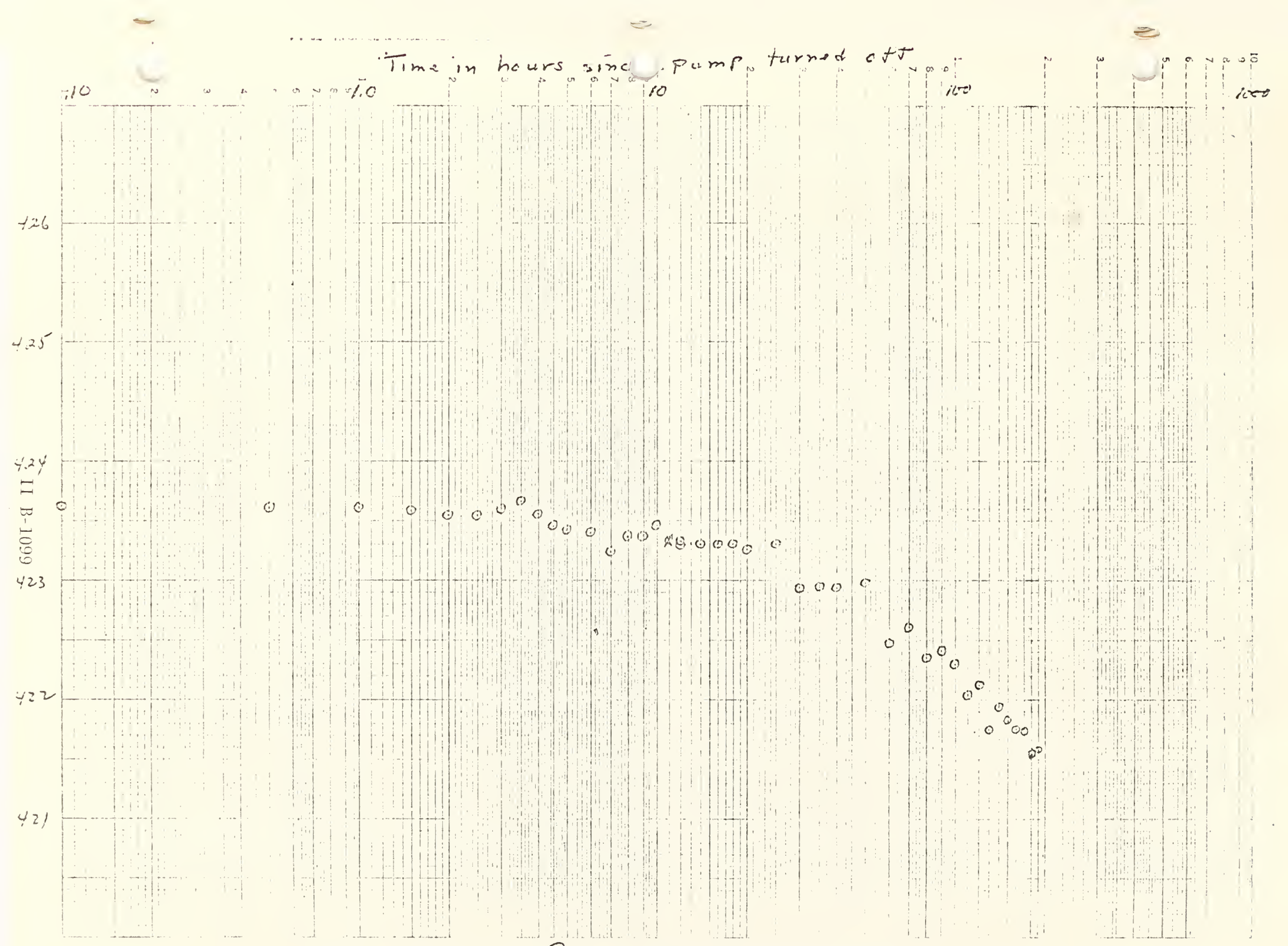


SG-10 String #1 Recovery Test 3-10-75 - 3-18-75

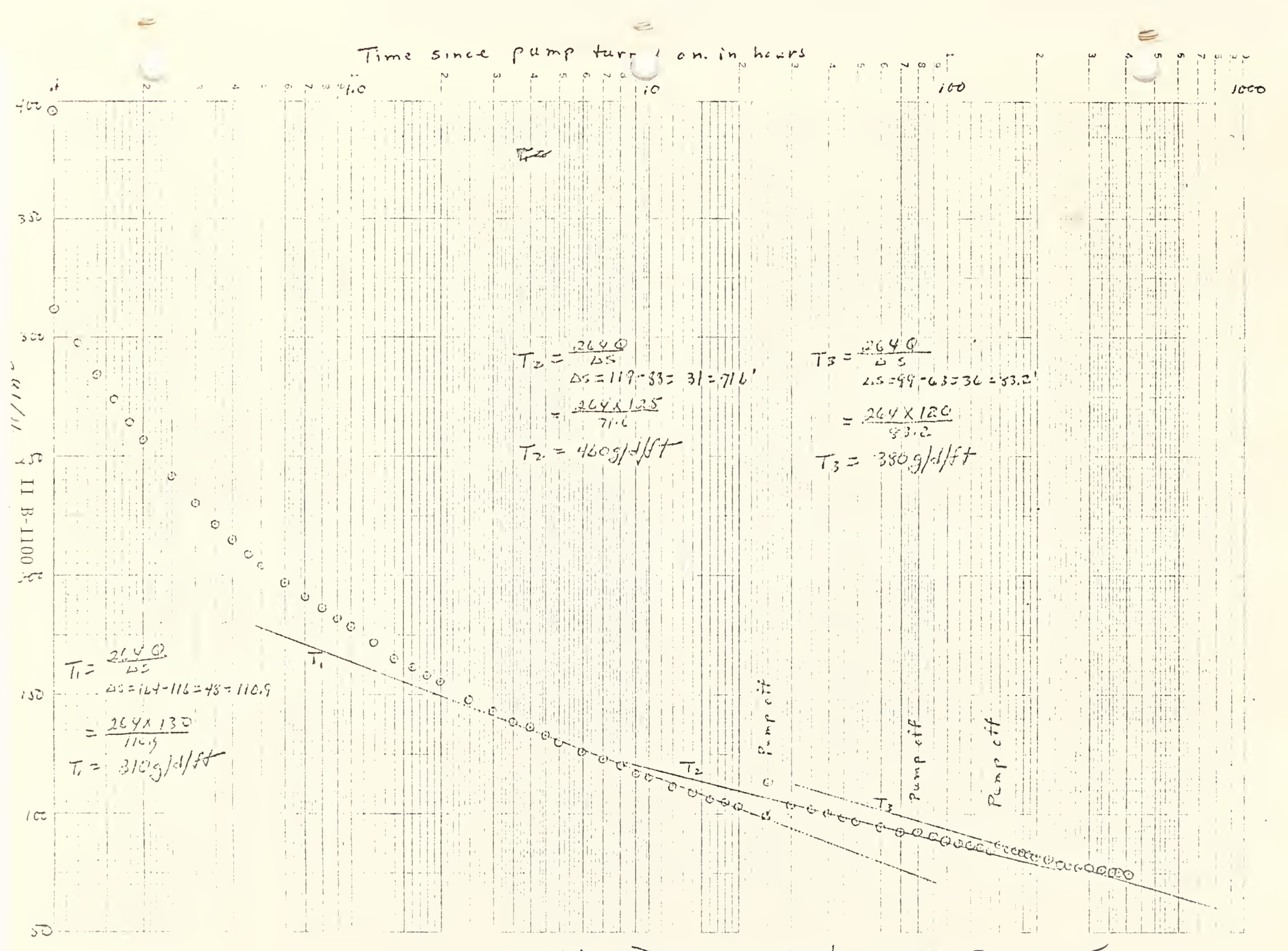


SG-10 String #2 Recovery Test 3-10-75 — 3-18-75


Time in hours since pump Turned off
730
720
710
700
Pressure loss in system.
SG-11 String #1 Recovery Test 3-10-75 — 3-18-75



SG-11 String #2 Recovery Test 3-10-75



$T_1 = \frac{264\,Q}{\Delta s}$

$\Delta s = 164 - 116 = 48 = 110.9'$

$= \frac{264 \times 130}{110.9}$

$T_1 = 310\,g/d/ft$

$T_2 = \frac{264\,Q}{\Delta s}$

$\Delta s = 119 - 88 = 31 = 71.6'$

$= \frac{264 \times 125}{71.6}$

$T_2 = 460\,g/d/ft$

$T_3 = \frac{264\,Q}{\Delta s}$

$\Delta s = 99 - 63 = 36 = 83.2'$

$= \frac{264 \times 120}{83.2}$

$T_3 = 380\,g/d/ft$

AT #1 - Draw down test. 2-28-75 - 3-10-75

SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6013

Time in hours since pump turned on

1.0 10 100 1000

460 440 420 400 380 360 340 320

ft. above M.S.L.

$T_1 S_1$

$T_2 S_2$

$T_1 = \frac{264\,Q}{\Delta s}$

$\Delta s = 443.2 - 406.5 = 33.7 = 77.8'$

$= \frac{264 \times 130}{77.8}$

$T_1 = 441.5$ g/d/ft

$S_1 = \frac{T\,t_o}{4800\,r^2}$ $r = 75'$

$= \frac{441 \times 24.6}{4800 \times 7225}$

$= \frac{1.08 \times 10^4}{3.47 \times 10^7}$

$S_1 = 3.11 \times 10^{-4}$

$T_2 = \frac{264\,Q}{\Delta s}$

$\Delta s = 451.8 - 406.5 = 42.3 = 97.7'$

$= \frac{264 \times 125}{97.7}$

$T_2 = 338.7$ g/d/ft

$S_2 = \frac{T\,t_o}{4800\,r^2}$

$= \frac{338 \times 46.8}{3.47 \times 10^7}$

$S_2 = 4.52 \times 10^{-4}$

AT #1 A - String #1 Drawdown Test - 2-23-75 — 3-10-75

SEMI LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6013

Time in hours since pump turned on.

.10 1.0 10 100

430
420
410
400
390
380
370
360

ft/min

II B-1102

Leaking pressure basin system
Recharged system

$T = \frac{264Q}{\Delta s}$

$\Delta s = 400.7 - 393.4 = 8.3 = 21.5'$

$= \frac{264 \times 135}{21.5}$

$T = 1535$ gpd/ft ?

$S = \frac{T t_o}{480 r^2}$ $r = 85'$

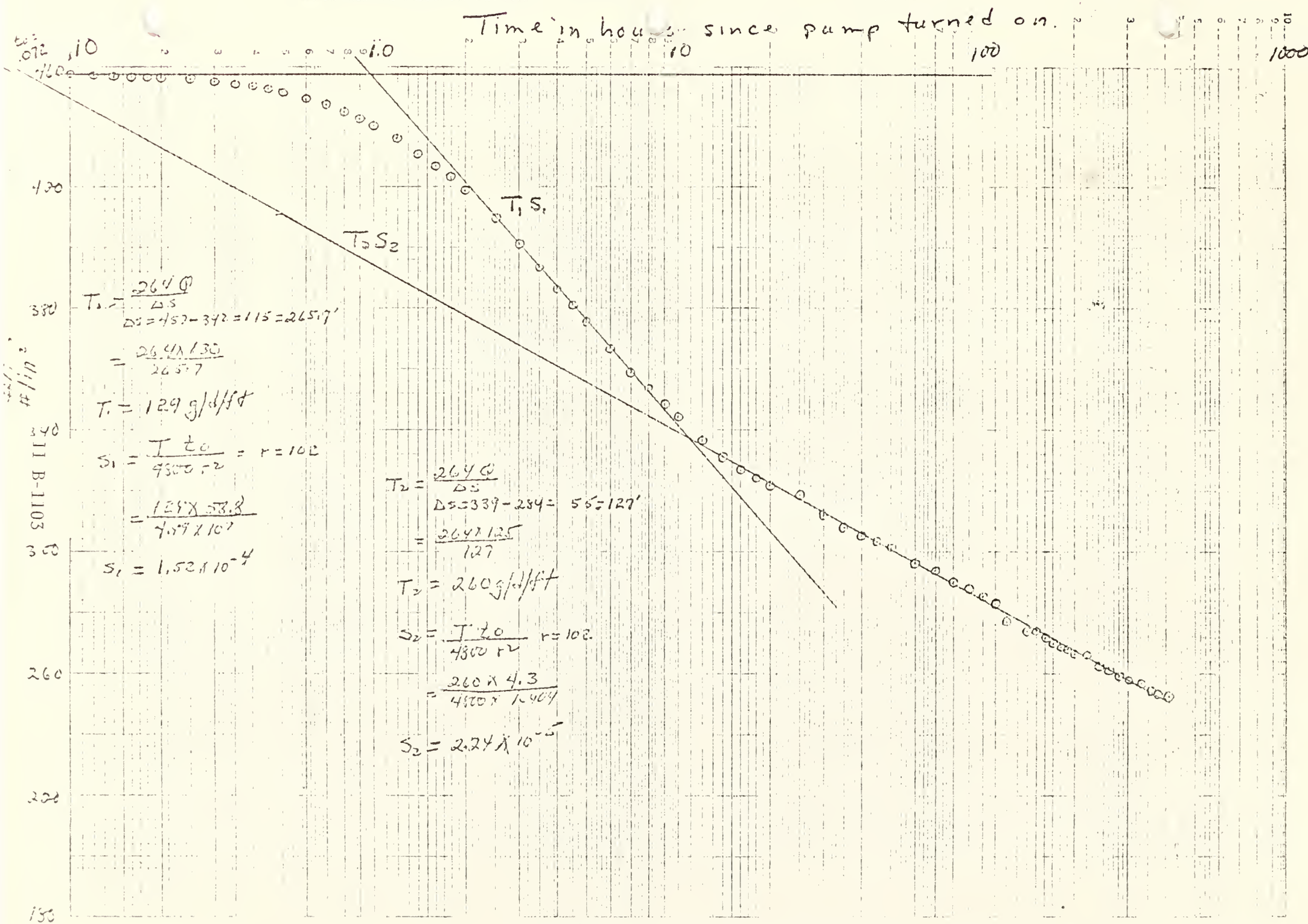
$= \frac{1535 \times 14400}{480 \times 7225}$

$S = 6.37 \times 10^{-1}$?

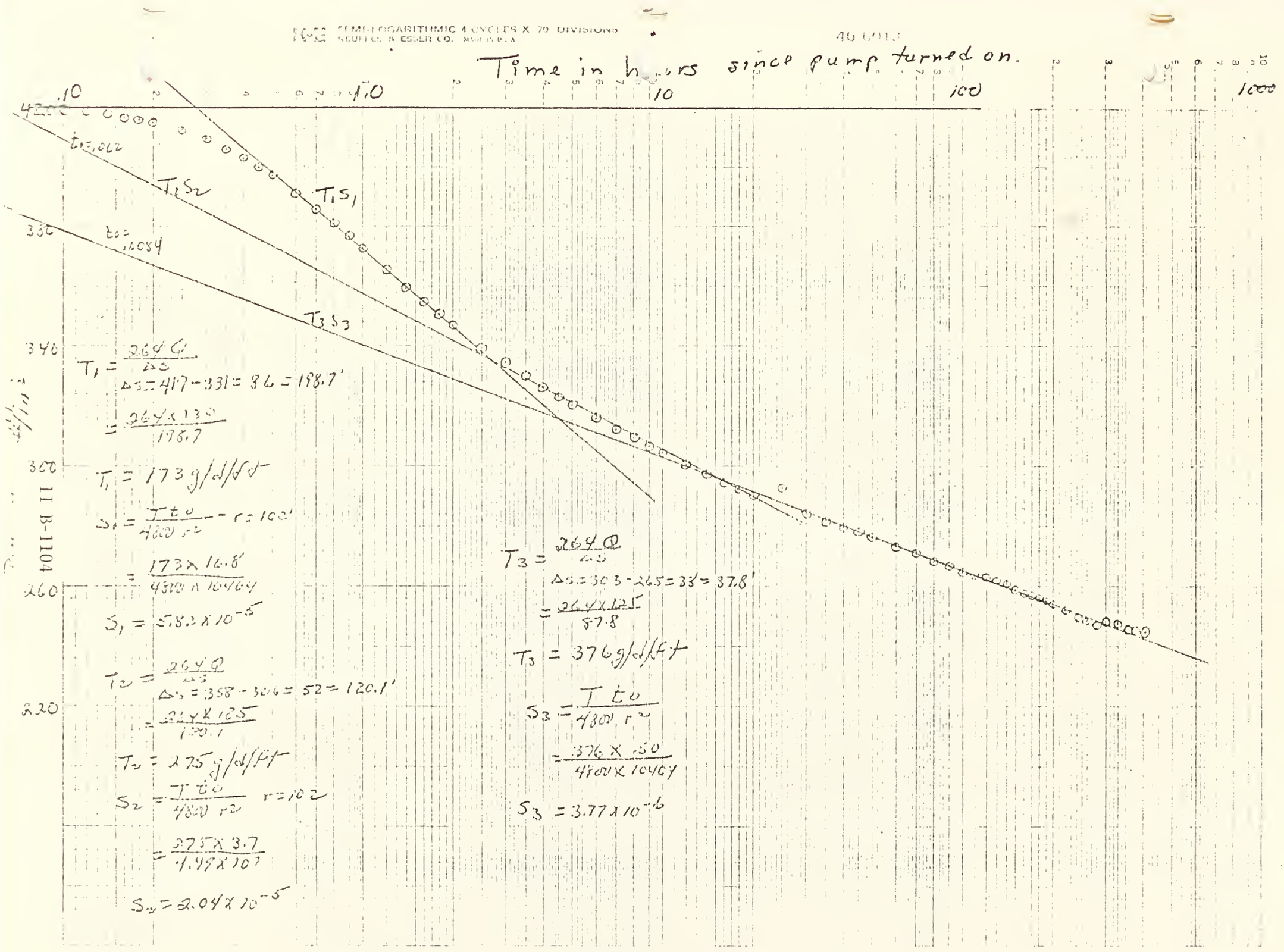
Data indicative of leaks in system.

AT #1A - String #2 Drawdown Test 2-28-75 — 3-10-75

46 0013



AT#/C - String #1 Drawdown test 2-21-75 - 3-10-75

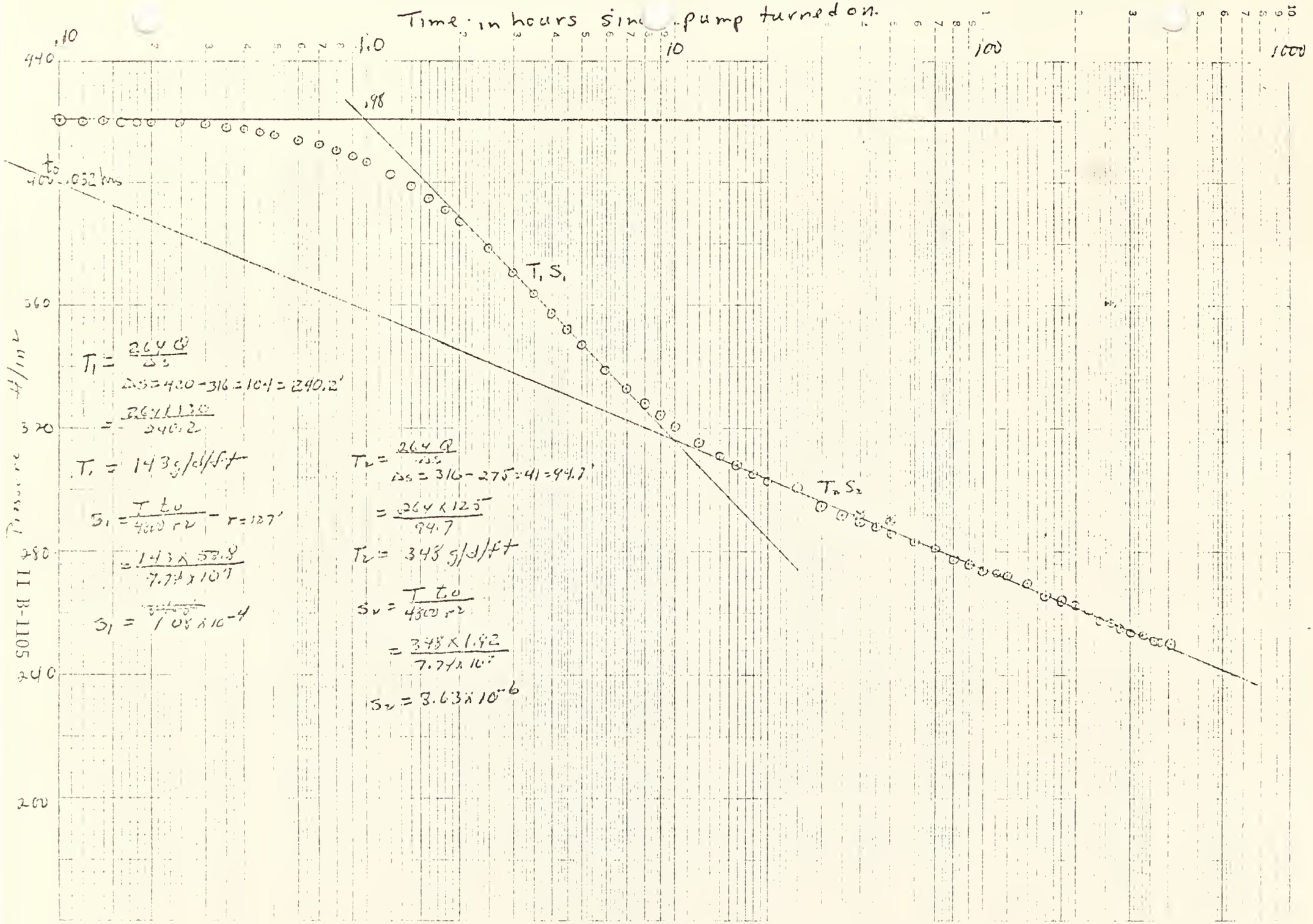


AT #1C - String #2 Drawdown Test 2-24-75-3-10-75

SEMI-LOGARITHMIC 1 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN USA

46 6013

Time in hours since pump turned on.



$T_1 = \frac{264\,Q}{\Delta s}$

$\Delta s = 430 - 316 = 104 = 240.2'$

$= \frac{264 \times 1.32}{240.2}$

$T_1 = 1.43$ g/d/ft

$S_1 = \frac{T\,t_o}{4000\,r^2}$ $r = 127'$

$= \frac{1.43 \times 58.8}{7.74 \times 10^4}$

$S_1 = 1.08 \times 10^{-4}$

$T_2 = \frac{264\,Q}{\Delta s}$

$\Delta s = 316 - 275 = 41 = 94.7'$

$= \frac{264 \times 1.25}{94.7}$

$T_2 = 3.48$ g/d/ft

$S_2 = \frac{T\,t_o}{4000\,r^2}$

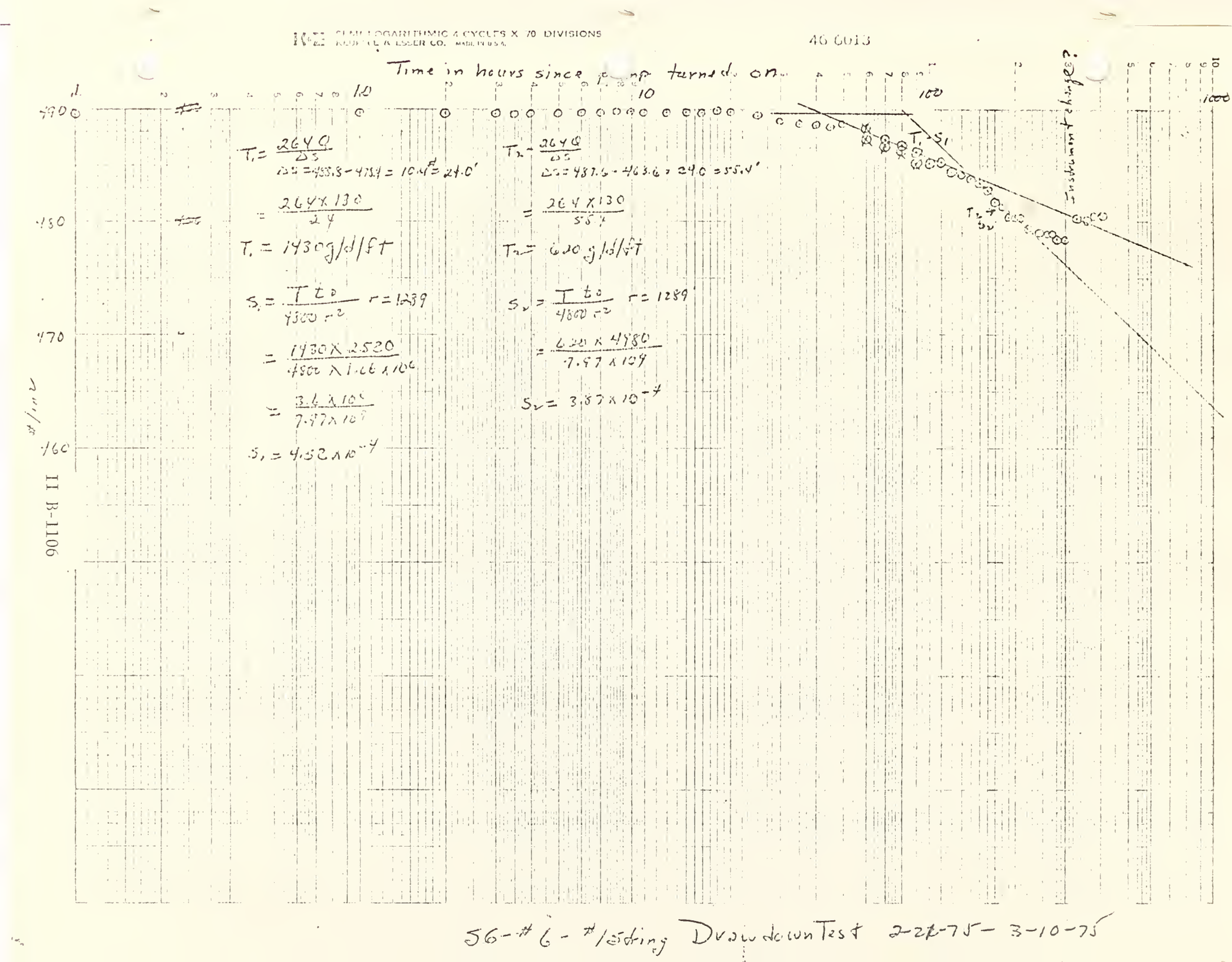
$= \frac{3.48 \times 1.82}{7.74 \times 10^4}$

$S_2 = 3.63 \times 10^{-6}$

AT #1D. - string #1 Drawdown Test 2-28-75 - 3-10-75

46 6013

Time in hours since pump turned on



$T_1 = \frac{264Q}{\Delta s}$

$\Delta s = 488.8 - 478.4 = 10.4 ft = 24.0'$

$= \frac{264 \times 130}{24}$

$T_1 = 1430 gpd/ft$

$S_1 = \frac{T t_0}{4800 r^2} \quad r = 1289$

$= \frac{1430 \times 2520}{4800 \times 1.66 \times 10^6}$

$= \frac{3.6 \times 10^6}{7.97 \times 10^9}$

$S_1 = 4.52 \times 10^{-4}$

$T_2 = \frac{264Q}{\Delta s}$

$\Delta s = 487.6 - 463.6 = 24.0 = 55.4'$

$= \frac{264 \times 130}{55.4}$

$T_2 = 620 gpd/ft$

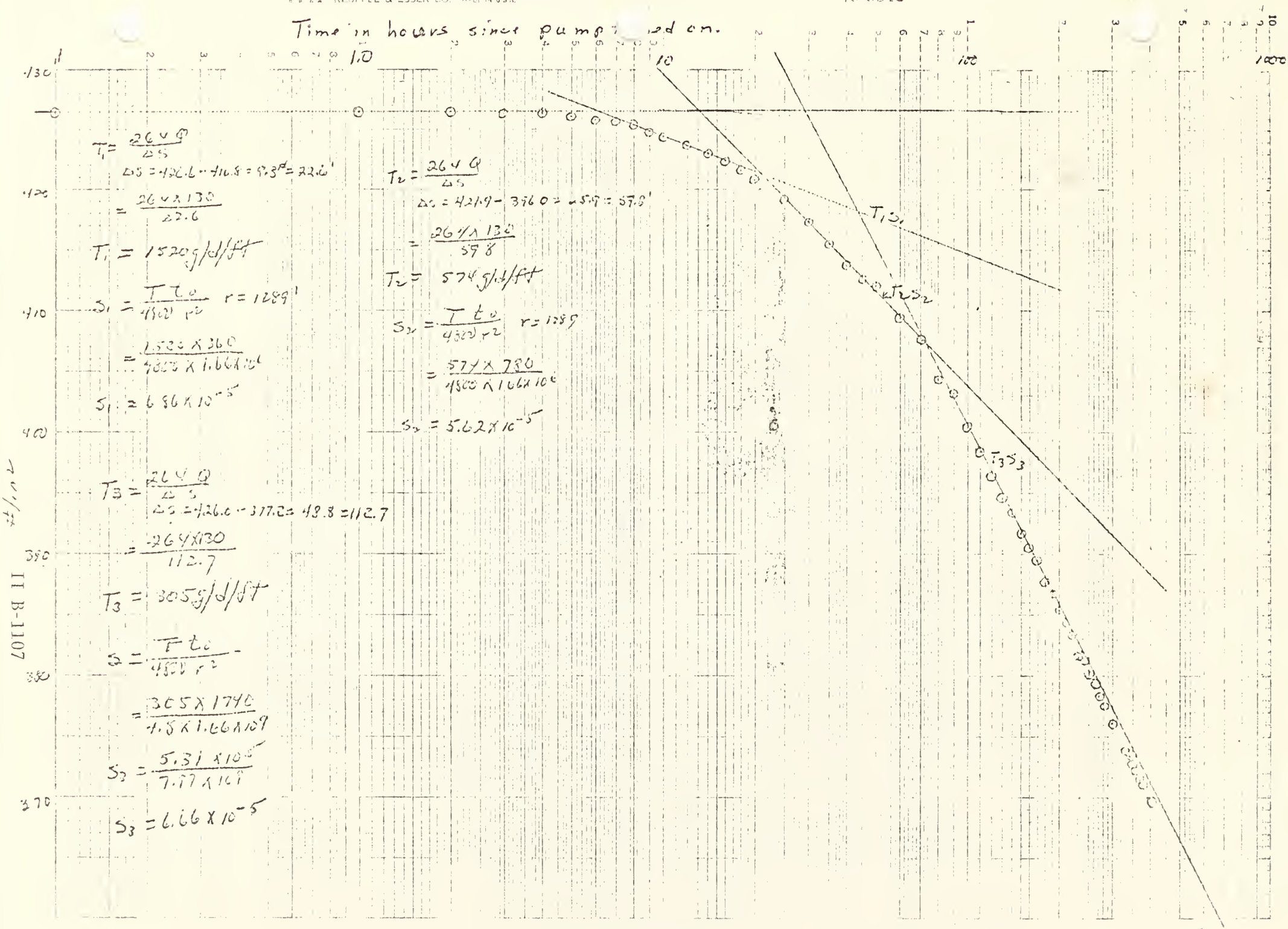
$S_2 = \frac{T t_0}{4800 r^2} \quad r = 1289'$

$= \frac{620 \times 4980}{7.97 \times 10^9}$

$S_2 = 3.87 \times 10^{-4}$

56-#6-#1 Testing Drawdown Test 2-28-75 - 3-10-75

46 6513



$T_1 = \frac{264 Q}{\Delta s}$

$\Delta s = 426.6 - 416.8 = 9.8^{ft} = 22.6'$

$= \frac{264 \times 130}{22.6}$

$T_1 = 1520 \text{ gpd/ft}$

$S_1 = \frac{T t_o}{4 \pi r^2}$ $r = 1289'$

$= \frac{1520 \times 360}{4 \pi \times 1.66 \times 10^6}$

$S_1 = 6.86 \times 10^{-5}$

$T_2 = \frac{264 Q}{\Delta s}$

$\Delta s = 421.9 - 396.0 = 25.9 = 59.8'$

$= \frac{264 \times 130}{59.8}$

$T_2 = 574 \text{ gpd/ft}$

$S_2 = \frac{T t_o}{4 \pi r^2}$ $r = 1289$

$= \frac{574 \times 730}{4 \pi \times 1.66 \times 10^6}$

$S_2 = 5.62 \times 10^{-5}$

$T_3 = \frac{264 Q}{\Delta s}$

$\Delta s = 426.6 - 377.2 = 49.8 = 112.7$

$= \frac{264 \times 130}{112.7}$

$T_3 = 305 \text{ gpd/ft}$

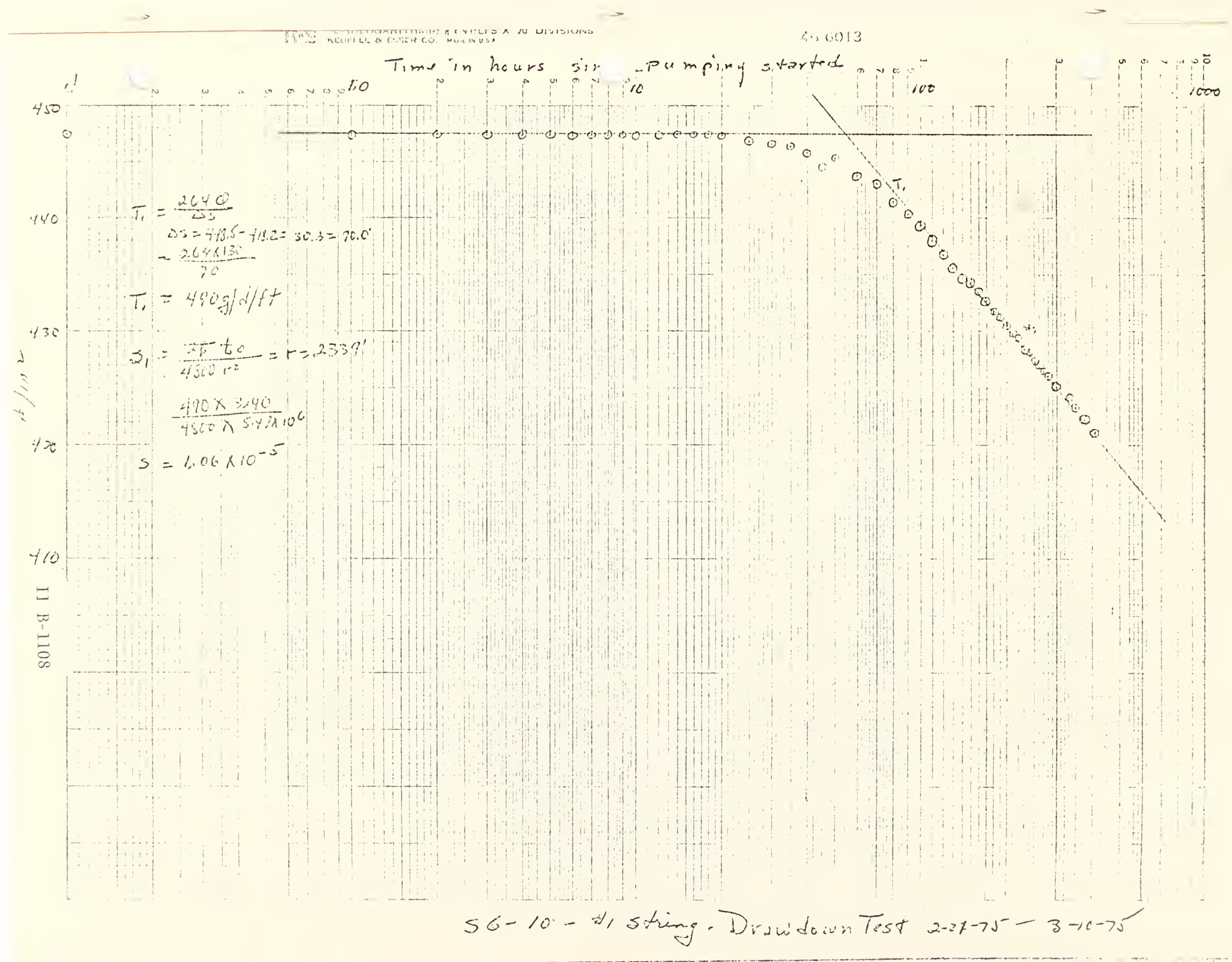
$S_3 = \frac{T t_o}{4 \pi r^2}$

$= \frac{305 \times 1740}{4.8 \times 1.66 \times 10^9}$

$S_3 = \frac{5.31 \times 10^{-5}}{7.77 \times 10^{1}}$

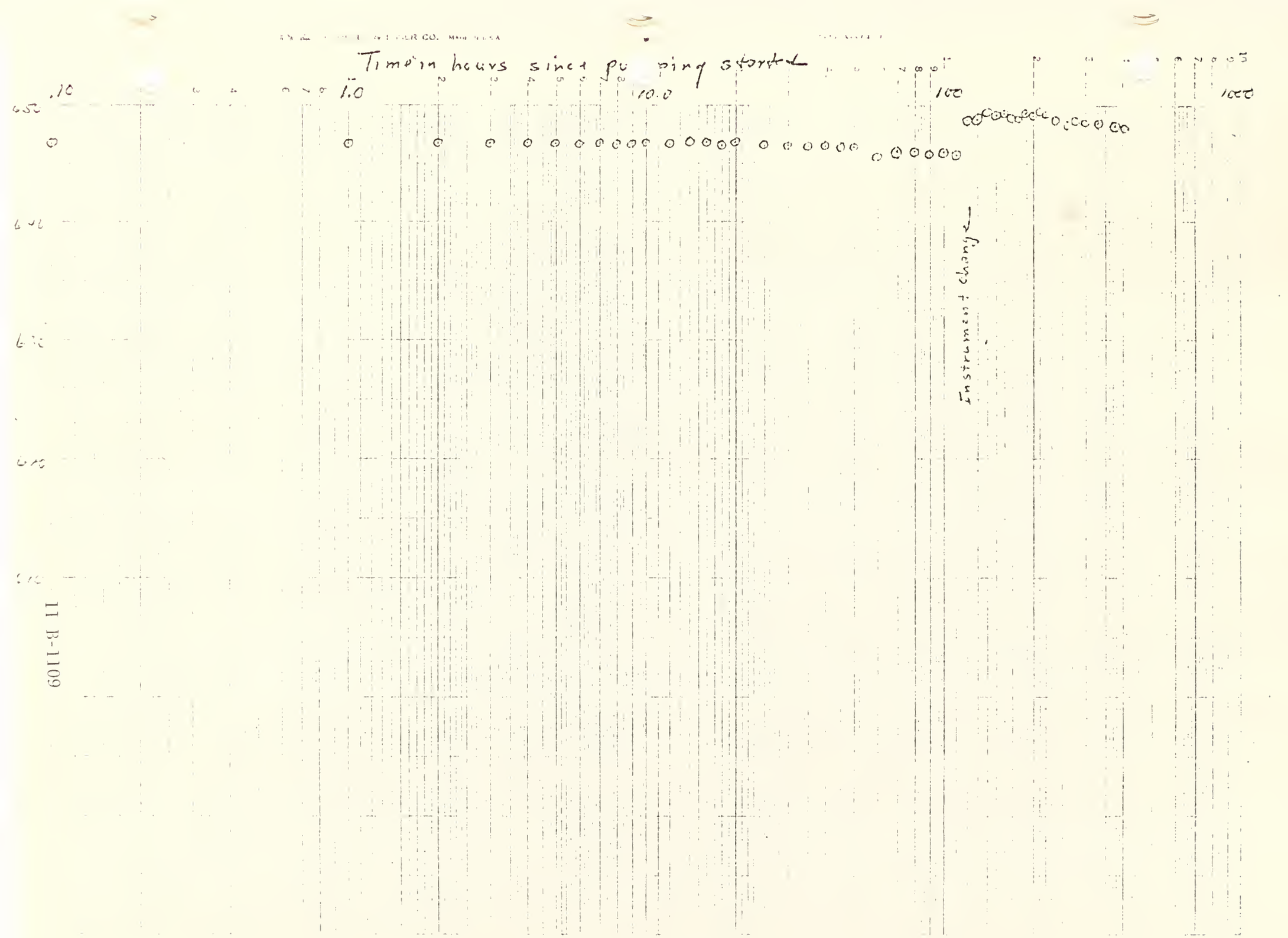
$S_3 = 6.66 \times 10^{-5}$

SG-6 #2 String Drawdown Test - 2-24-75 — 3-10-75

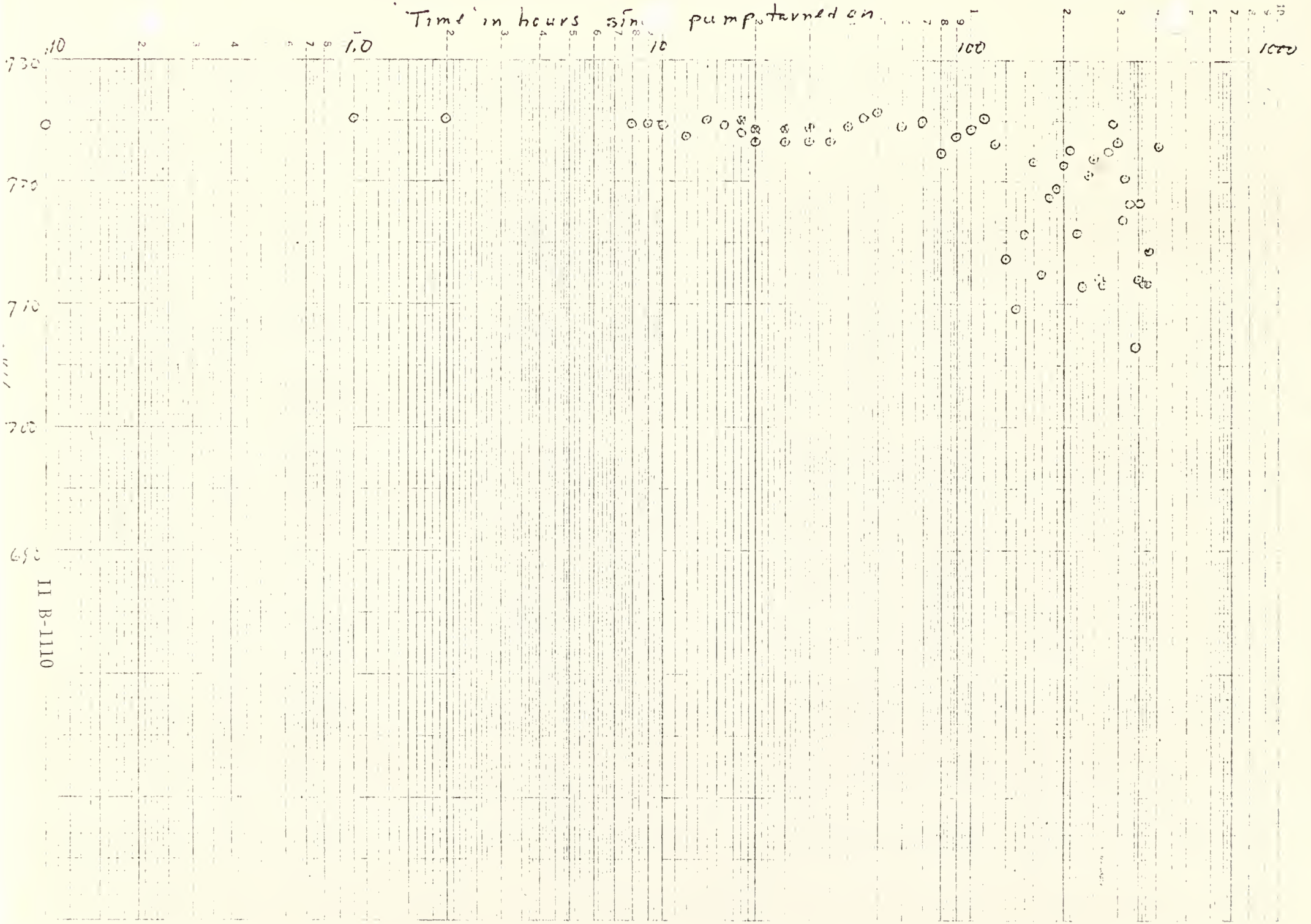


II B-1108

S6-10-#1 string. Drawdown Test 2-27-75 — 3-10-75

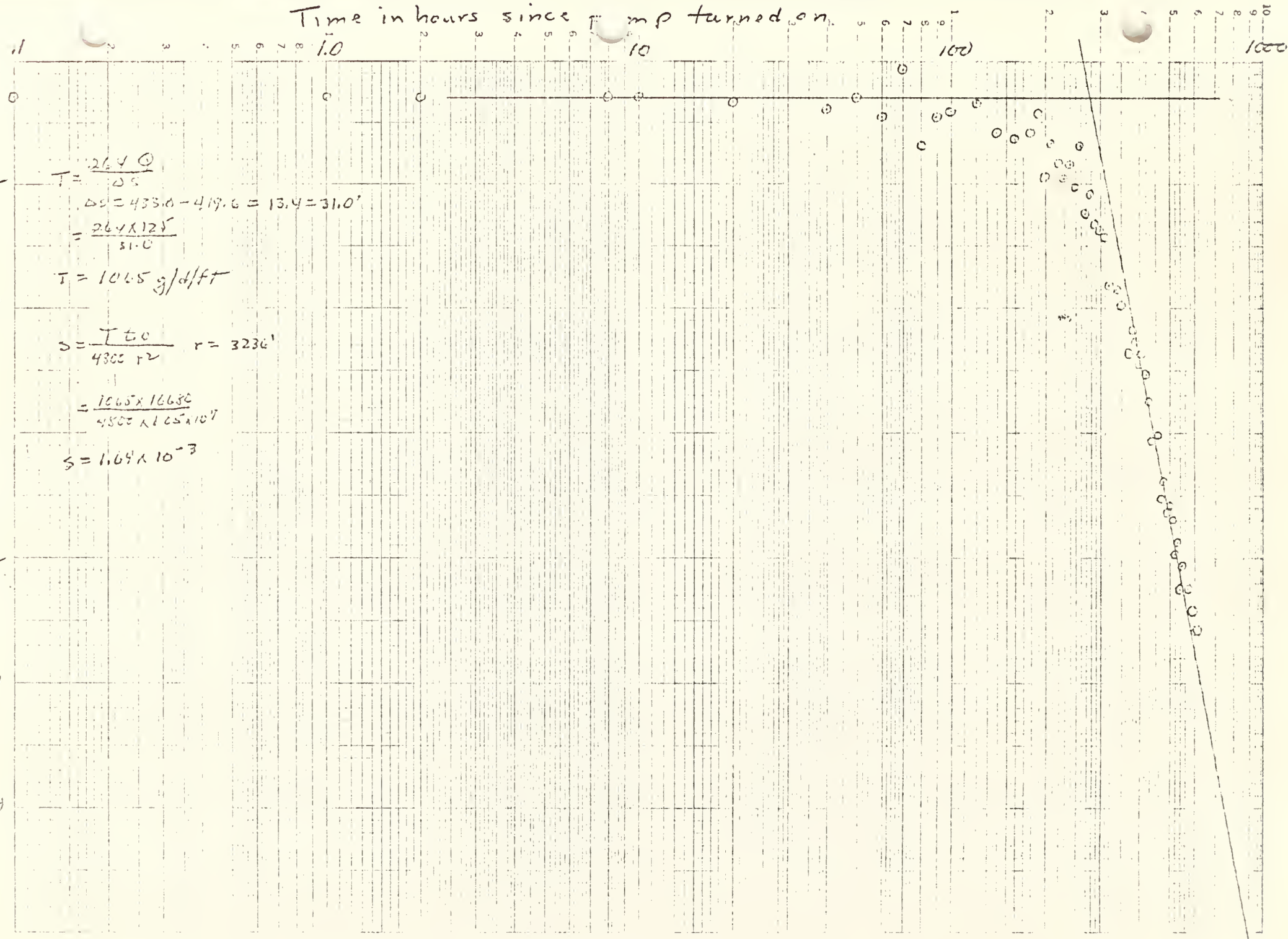


56-10 #2 String Drawdown Test 2-27-75 – 3-10-75



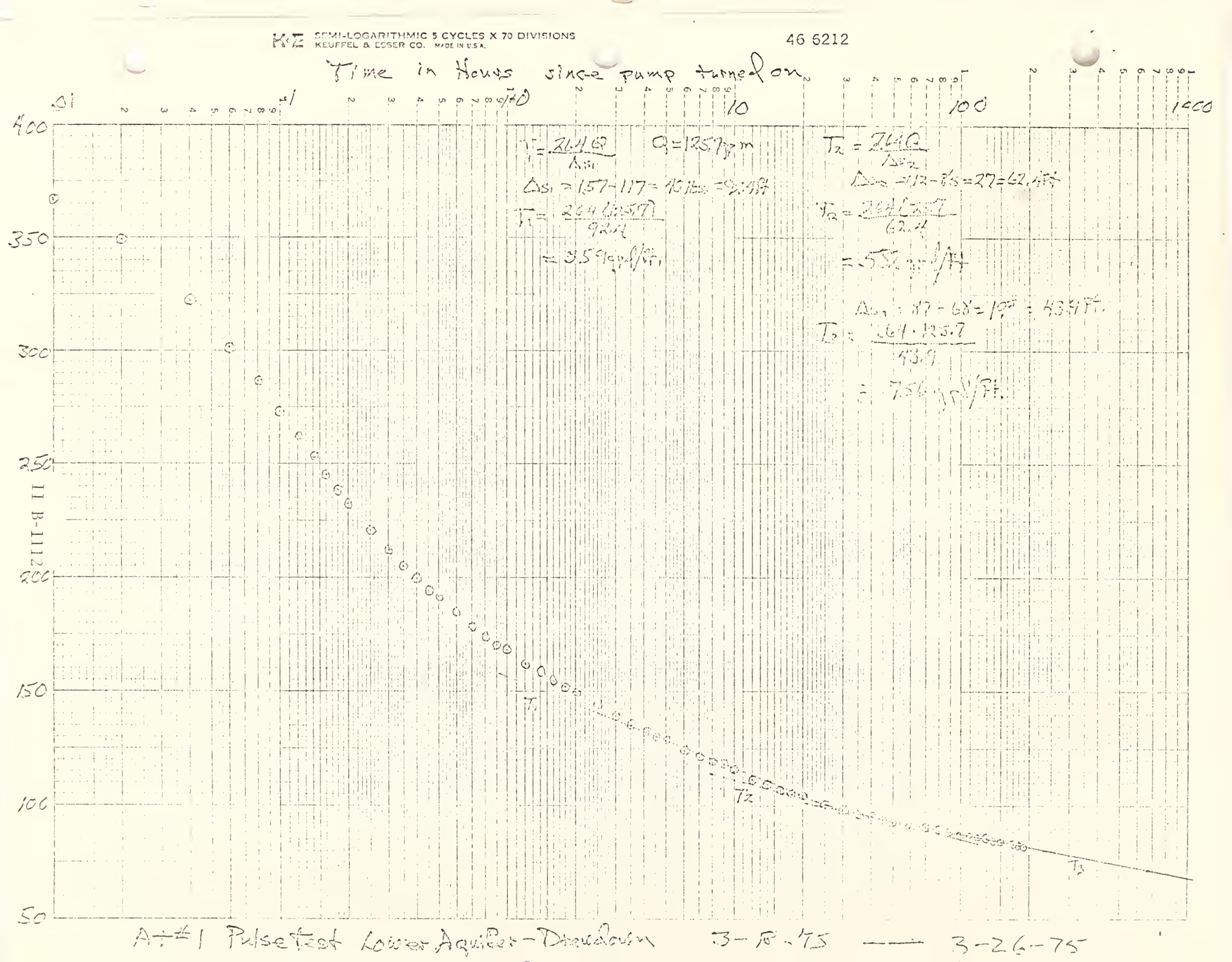
II B-1110

S6-11 String #1 Drawdown Test 2-21-75 — 3-10-75



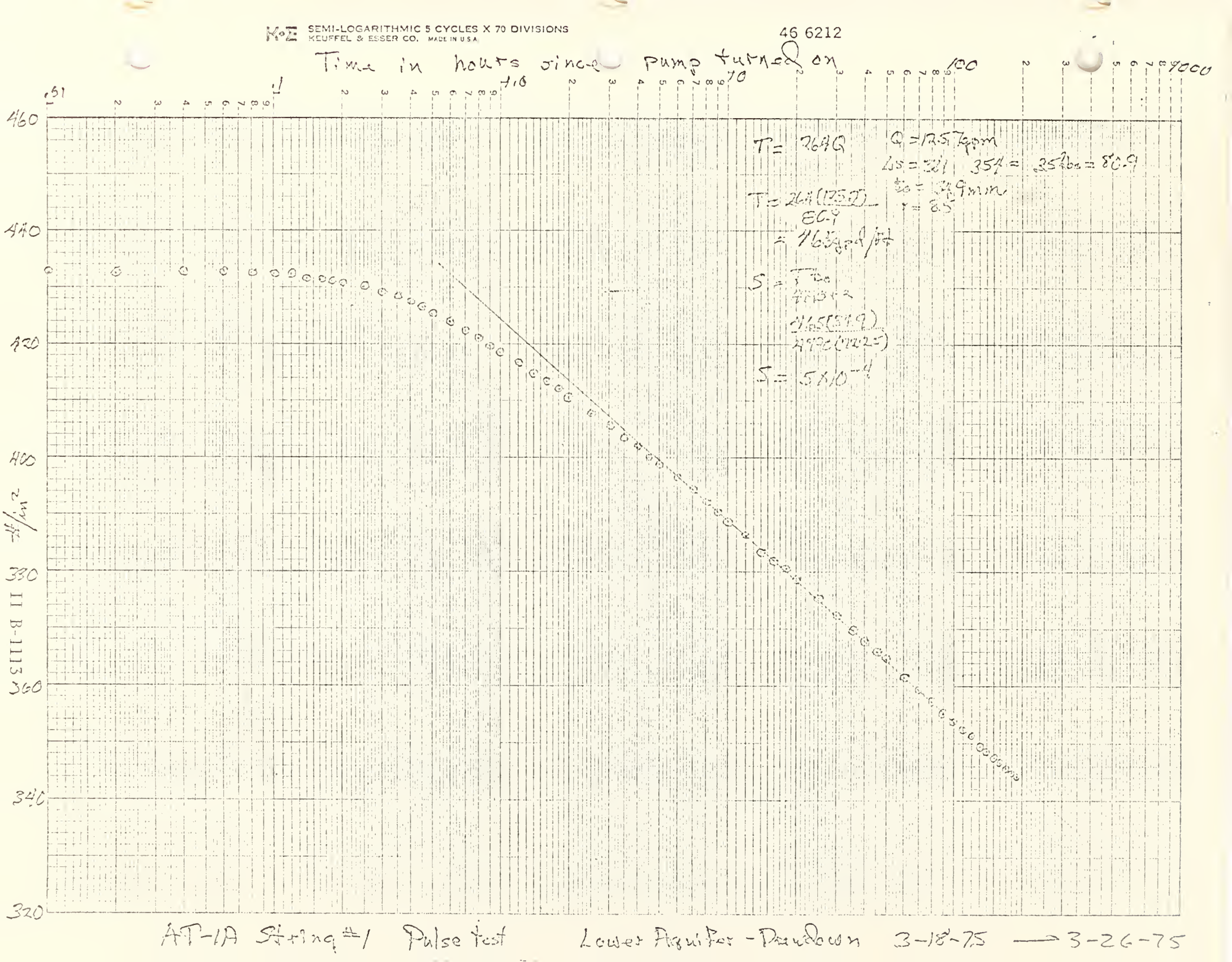
S 6-11 - String #2 Drawdown Test 2-21-75 - 3-10-75

46 6212



A+E1 Pulsetest Lower Aquifer - Drawdown 3-5-75 —— 3-26-75

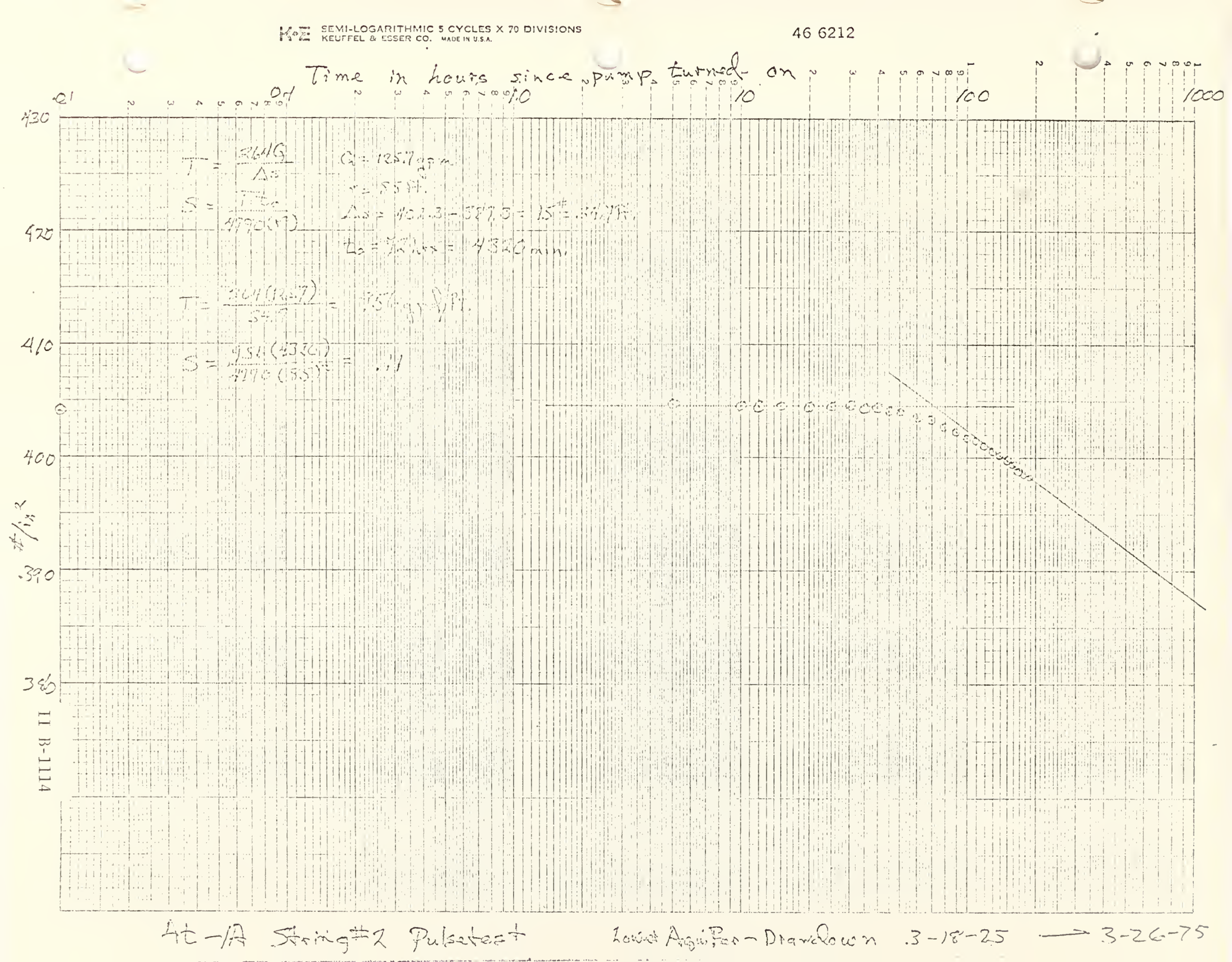
46 6212



AT-1A String #1 Pulse test Lower Aquifer - Drawdown 3-18-75 → 3-26-75

K&E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212

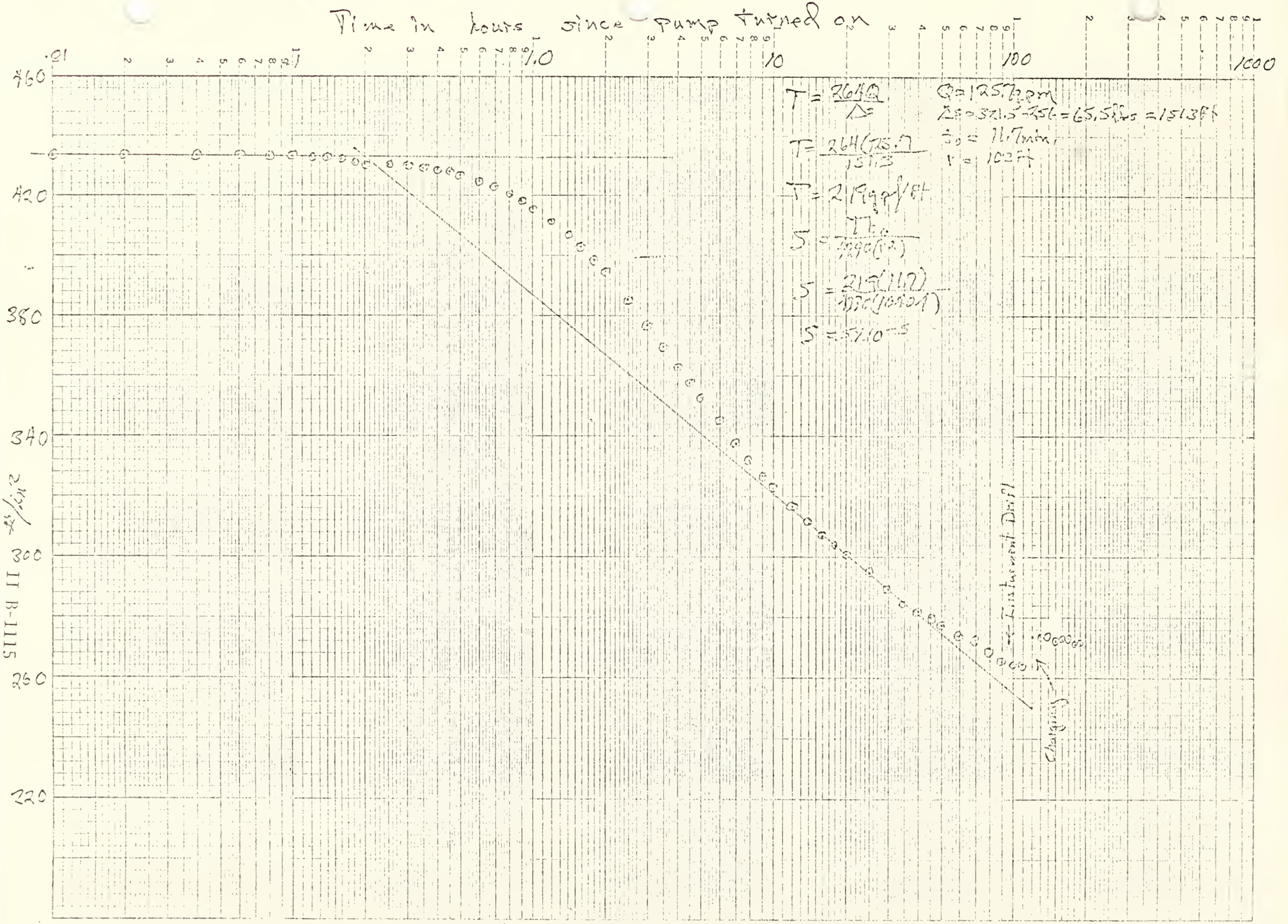


II B-1114

At-1A String #2 Pulsetest Lowest Aquifer - Drawdown .3-18-25 → 3-26-75

K&E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

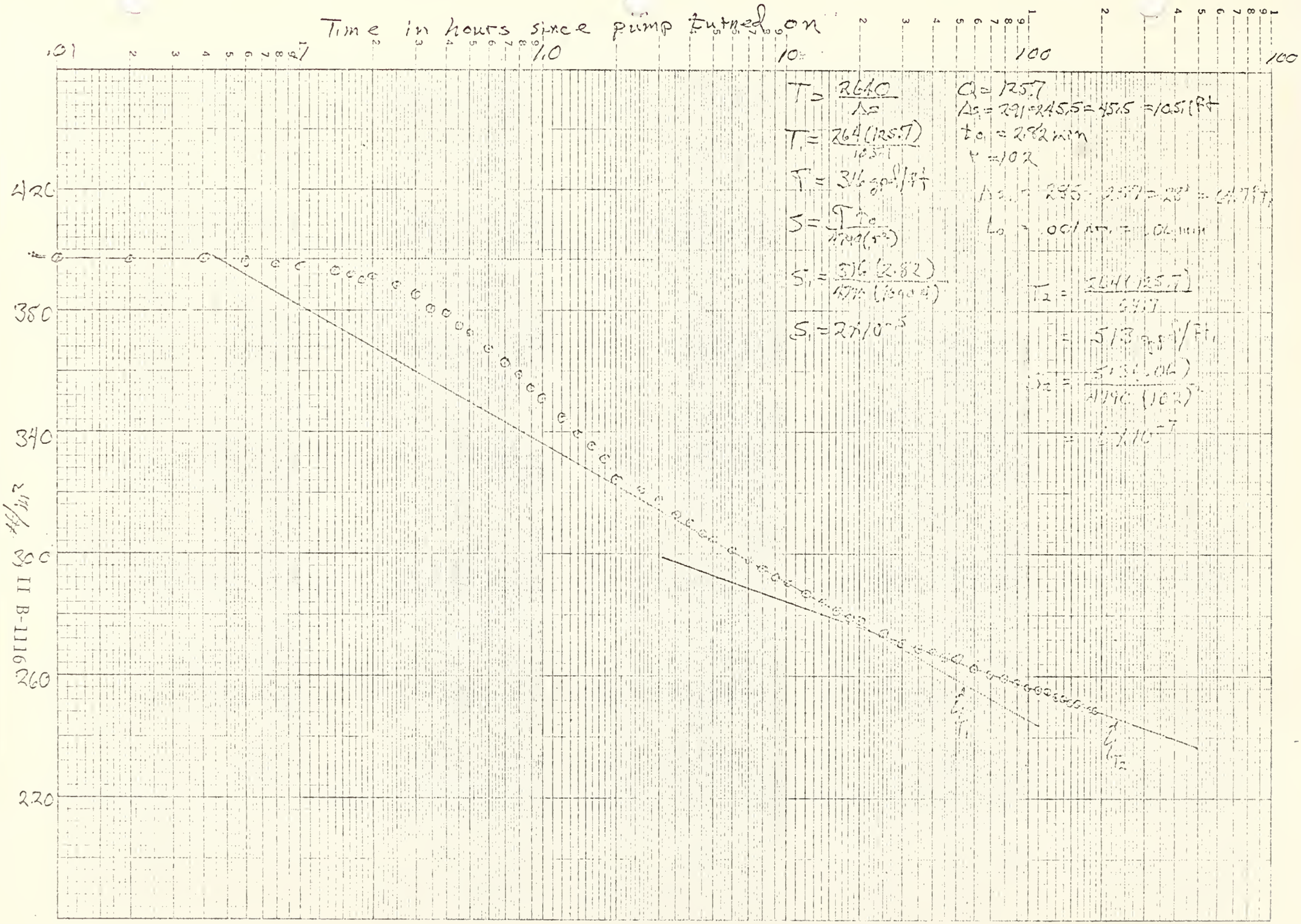
46 6212



At-1C String #1 Pulse Test Lower Aquifer test - Drawdown 3-18-75 → 3-26-75

K&E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212



APIC String #2 Pulse Test Lower Aquifer - Drawdown 3-18-75 → 3-26-75

46 6212

$T = \frac{264Q}{\Delta s}$

$Q = 125.7$ gpm

$\Delta s_1 = 300 - 247 = 53$ ft $= 122.4$ ft

$t_{o_1} = 9.6$ min.

$r = 127$ ft

$T_1 = \frac{264(125.7)}{122.4}$

$T_1 = 271$ gpd/ft.

$S = \frac{Tbt_o}{1500r^2}$

$S_1 = \frac{271(9.6)}{1210(16129)}$

$S_1 = 3 \times 10^{-5}$

$\Delta s_2 = 291.5 - 247.5 = 44$ ft $= 101.6$ ft

$t_{o_2} = .0022$ hrs. $= .165$ min.

$T_2 = \frac{264(125.7)}{101.6}$

$= 327$ gpd/ft.

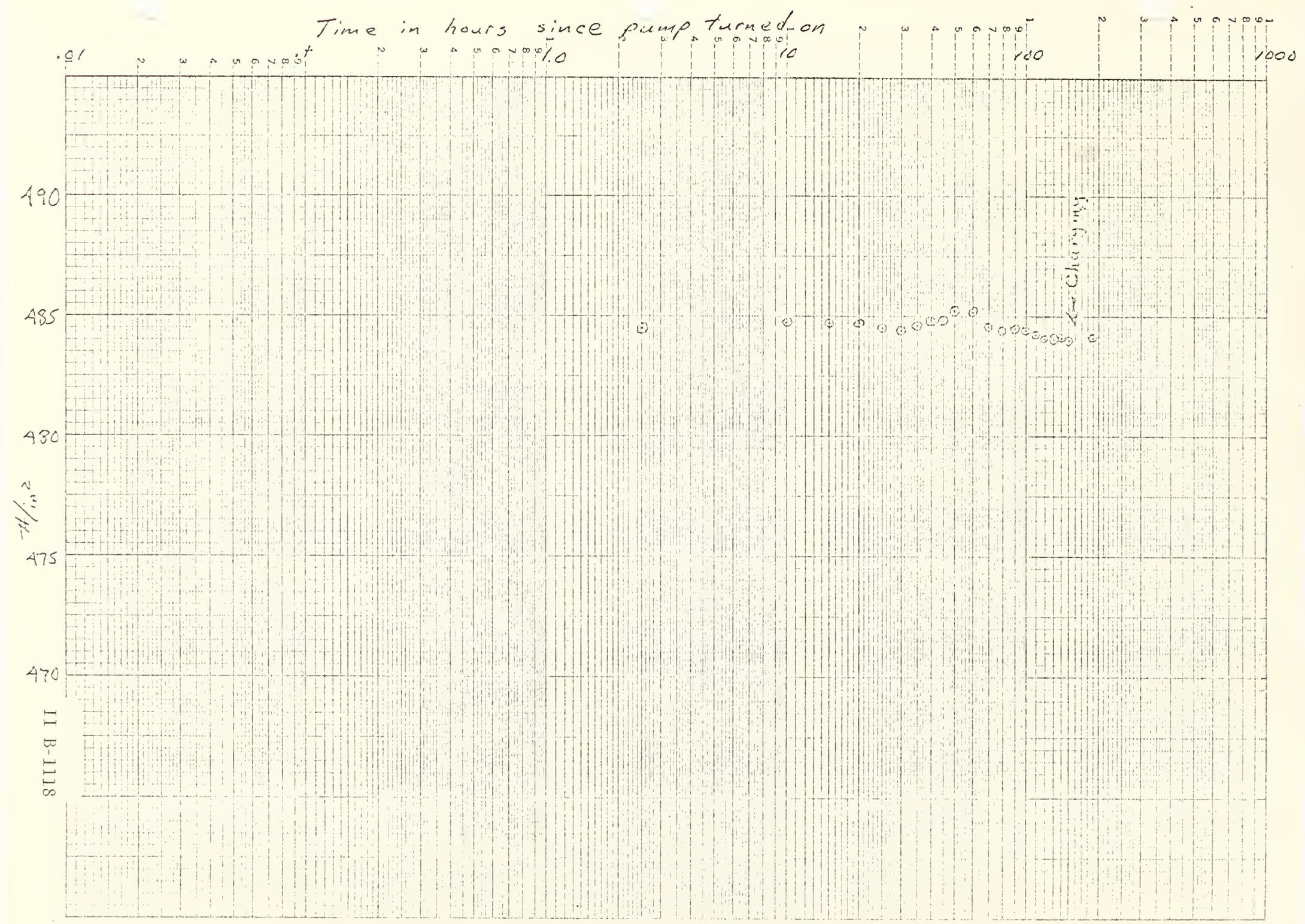
$S_2 = \frac{327(.165)}{1790(127)^2}$

$= 7 \times 10^{-7}$

T_1 T_2 t_{o_1} t_{o_2}

AT-1D -String #2 Lower Aquifer Pulse Test - Drawdown 3-18-75 ⟶ 3-26-75

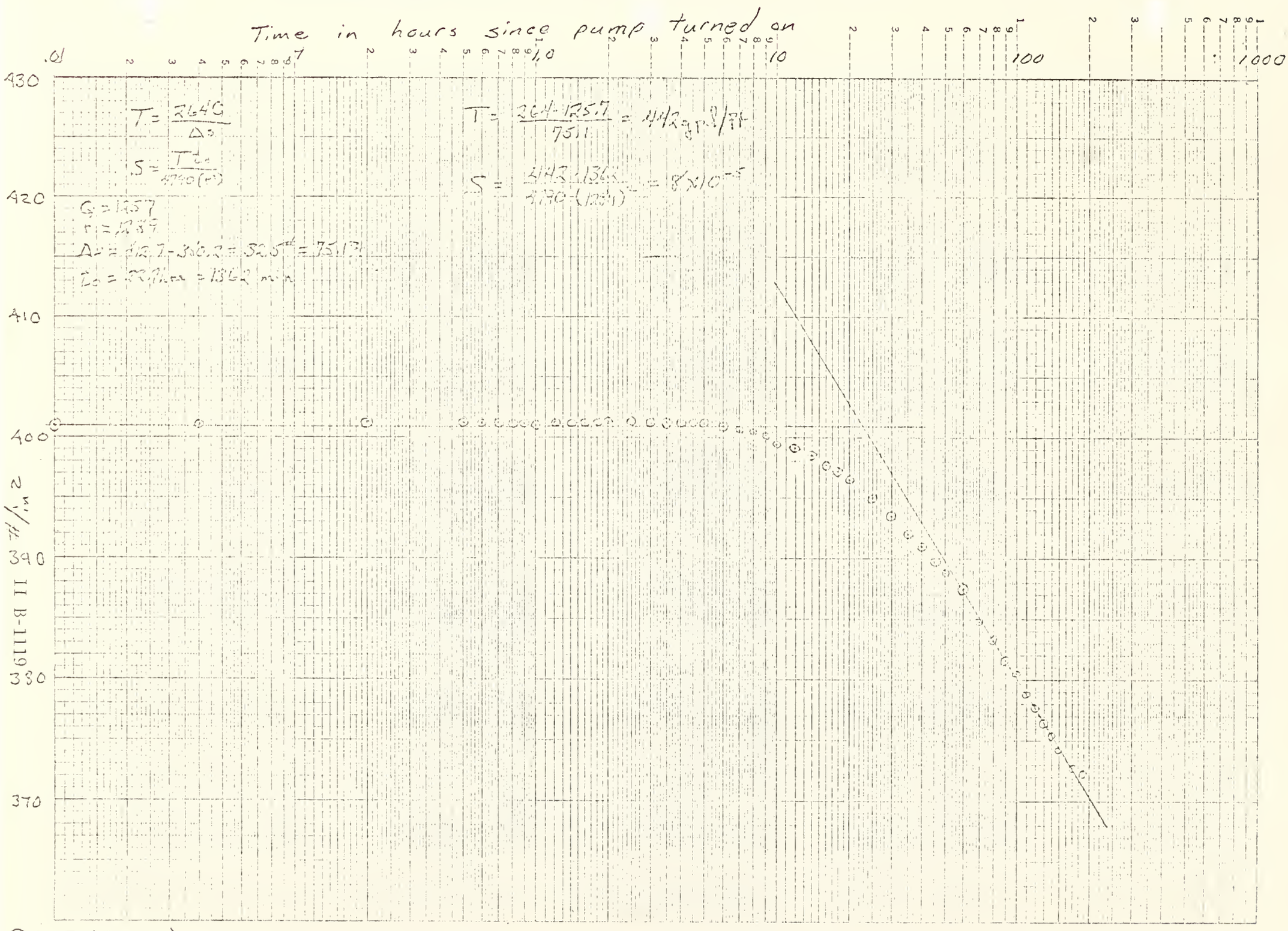
46 6212



Pulse Test Lower Aquifer

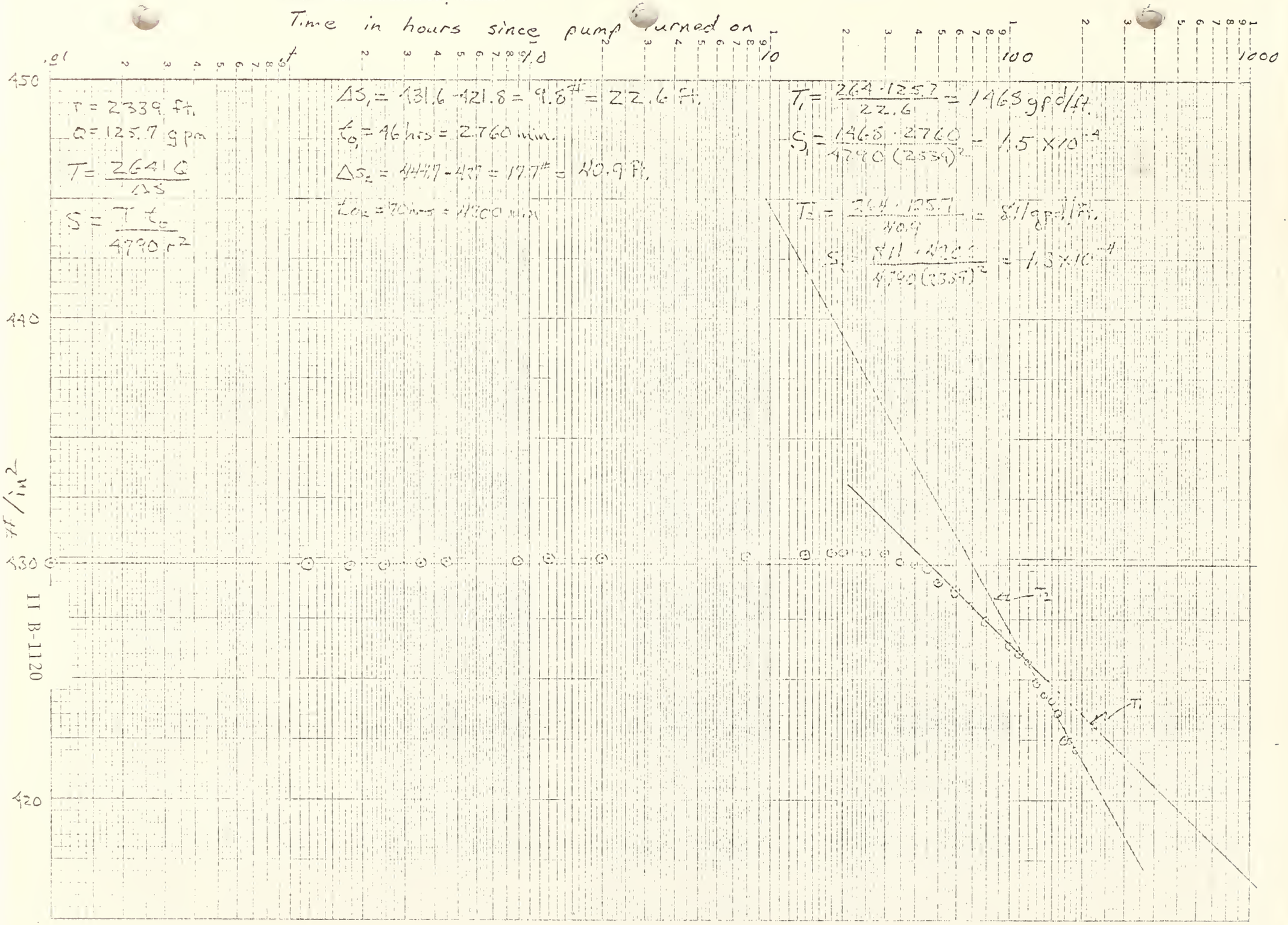
56-6 #1 String Drawdown Test 3-18-75 — 3-26-75

40 0212



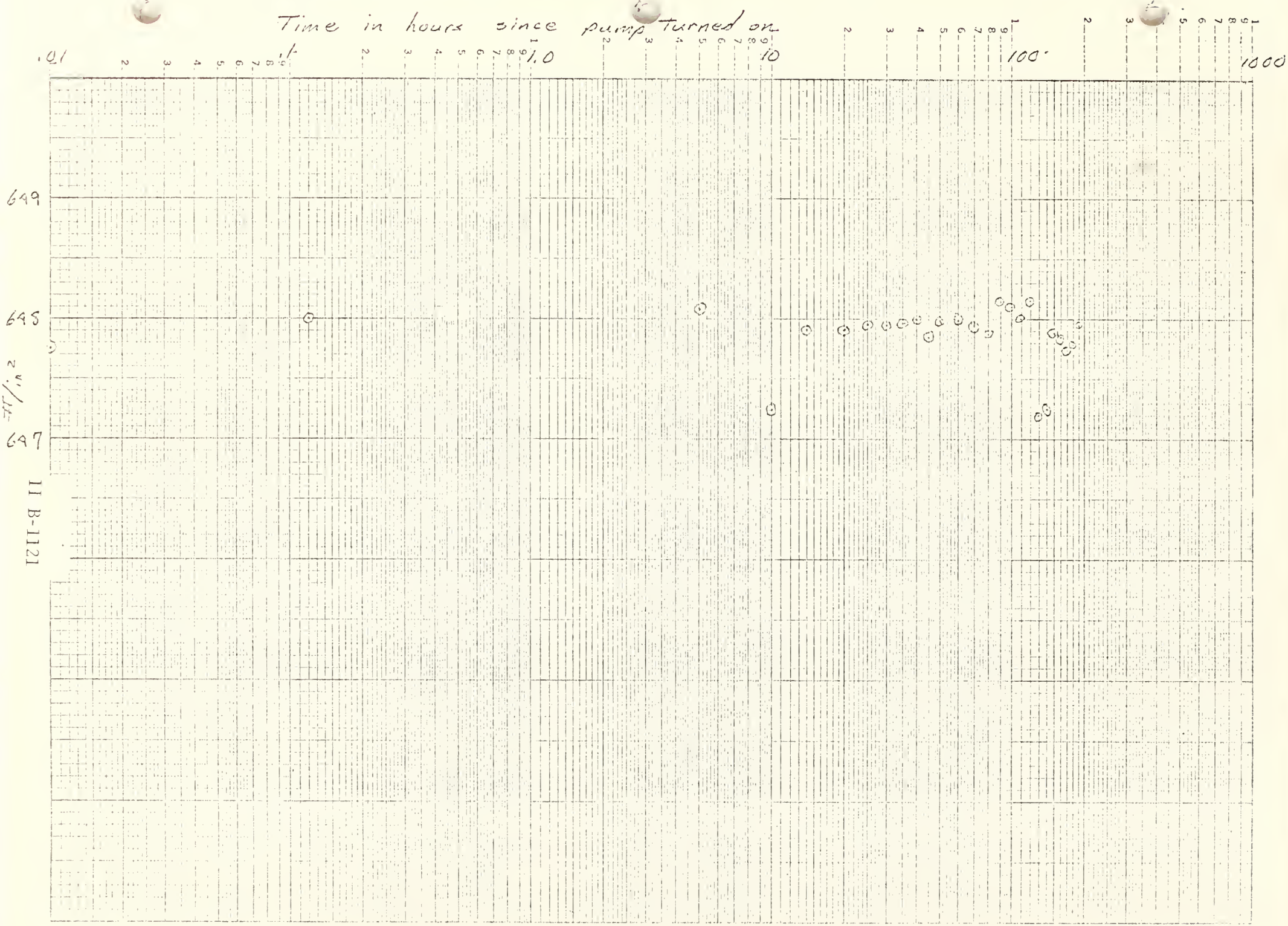
Pulse Test Lower Aquifer 56-6 # 2 string Drawdown Test 3-18-75 — 3-26-75

46 6212



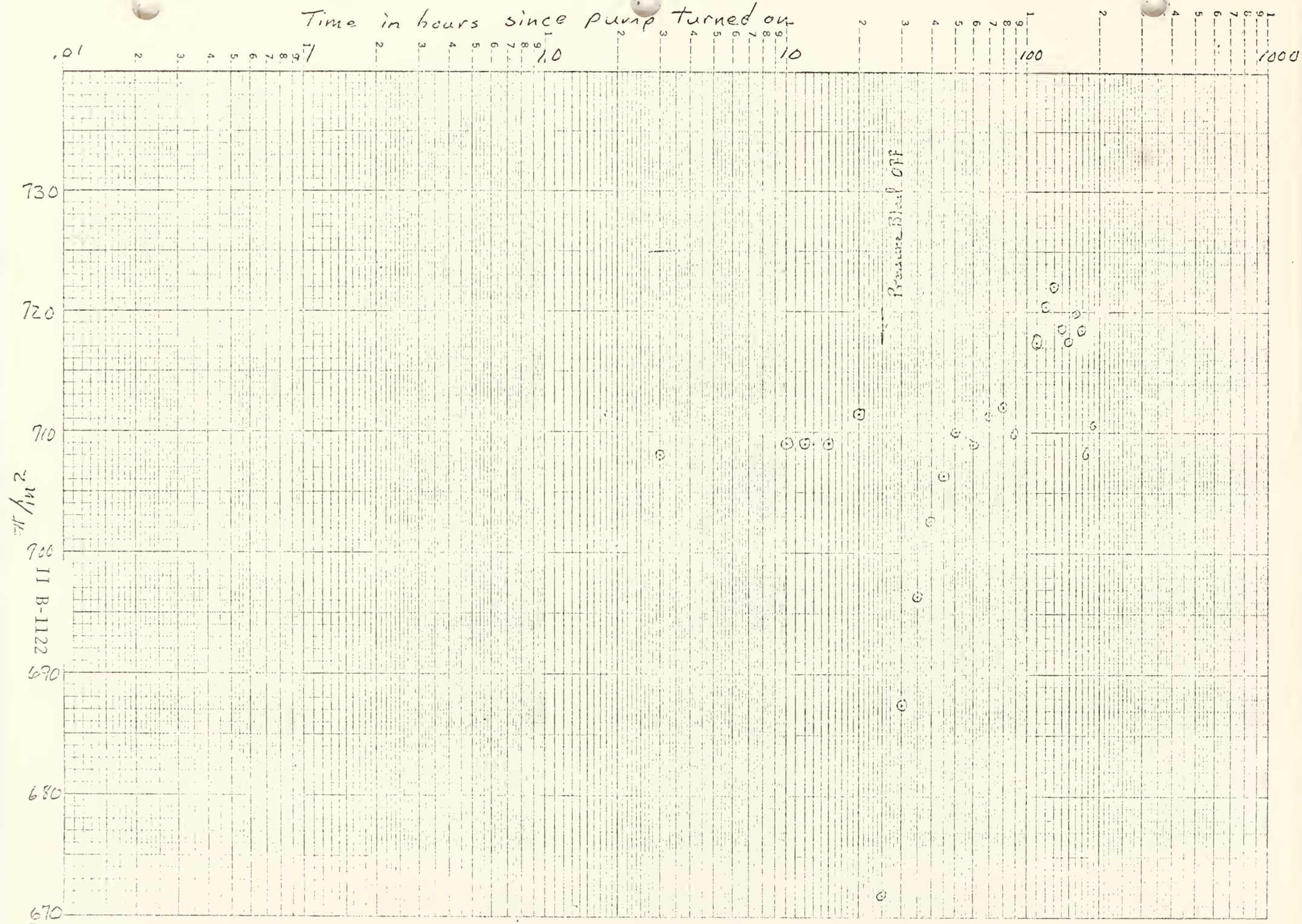
Pulse Test 56-10 String #1 Drawdown Test 3-18-75 — Lower Aquifer 3-26-75

46 6212

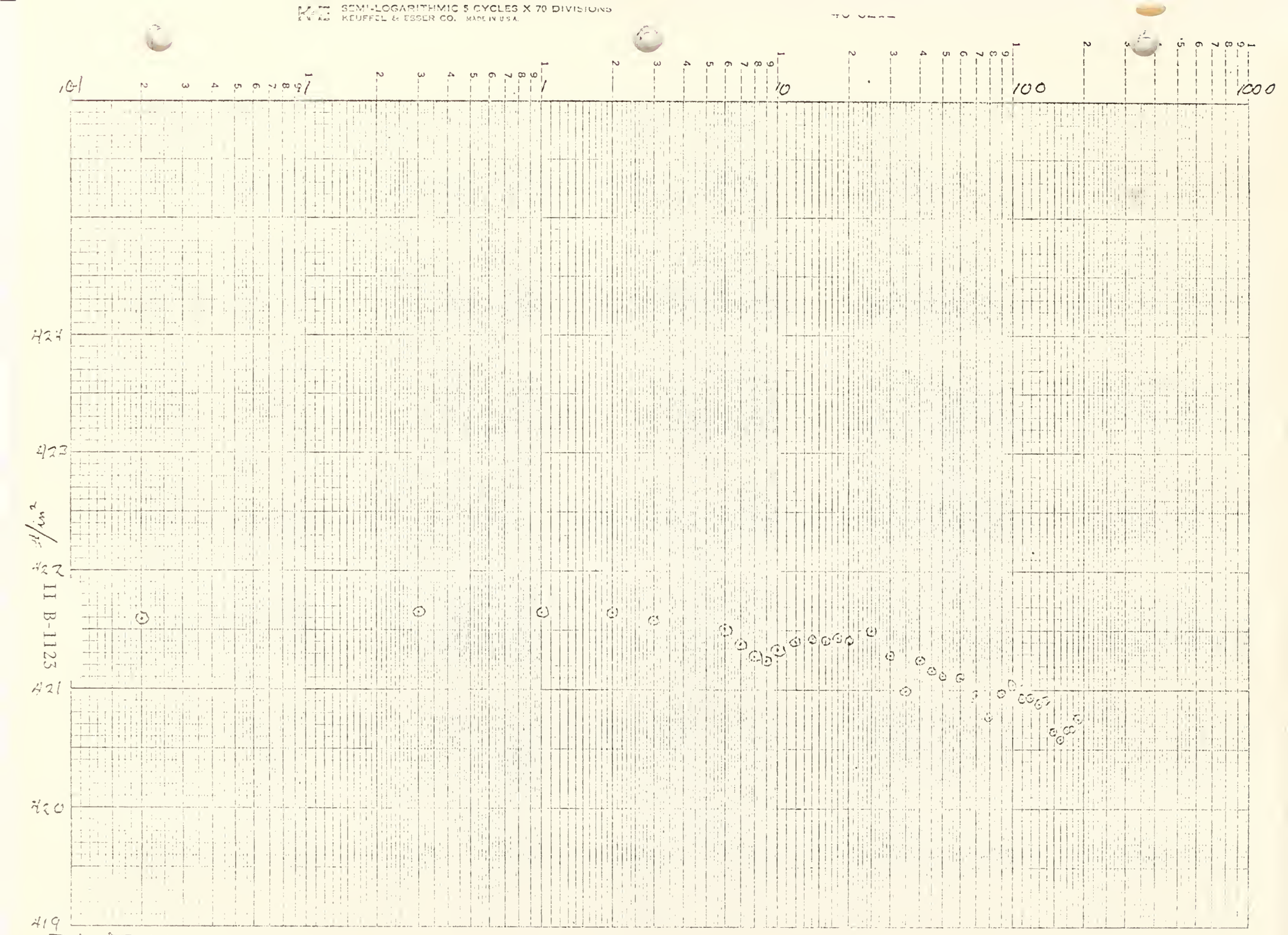


Pulse Test 56-10 string #2 Drawdown 3-18-75 — Lower Aquifer 3-26-75

46 6212



Pulse Test Lower Aquifer SG-11 String #1 Drawdown Test 3-18-75 — 3-26-75



Pulse Test-Lower Aquifer SG-11 #2 String 2 Drawdown test 3-18-75 ⟶ 3-26-75

LOWER AQUIFER PUMP TEST

FINAL RECOVERY CURVES

TABLE II B-54

TRANSMISSIVITY and STORAGE COEFFICIENT VALUES

Lower Aquifer Pump Test

Well No.	Final Recovery
AT#1	T = 194.7 gpd/ft. Initial T = 351.0 gpd/ft. Final
AT#1A (String #1)	T = 333.4 gpd/ft.; S = 6.4×10^{-4} Initial T = 365.4 gpd/ft.; S = 5.3×10^{-4} Final
(String #2)	NO VALID RESPONSE
AT#1C (String #1)	T = 133.4 gpd/ft.; S = 1.8×10^{-4} Initial T = 310.3 gpd/ft.; S = 1.5×10^{-5} Final
(String #2)	T = 226 gpd/ft.; S = 5.2×10^{-5} Initial T = 346.9 gpd/ft.; S = 1.4×10^{-5} Final
AT#1D (String #1)	T = 303.2 gpd/ft.; S = 2.5×10^{-5} Initial T = 360.5 gpd/ft.; S = 1.1×10^{-5} Final
SG-6 (String #1)	T = 380.8 gpd/ft.; S = 1.02×10^{-3}
(String #2)	T = 400.5 gpd/ft.; S = 8×10^{-5}
SG-10 (String #1)	T = 694.6 gpd/ft.; S = 1.4×10^{-5}
(String #2)	NO RESPONSE
SG-11 (String #1)	NO USABLE RESPONSE DUE TO HIGH GAS PRESSURE POSSIBLE
(String #2)	NO USABLE RESPONSE DUE TO INSTRUMENT DRIFT

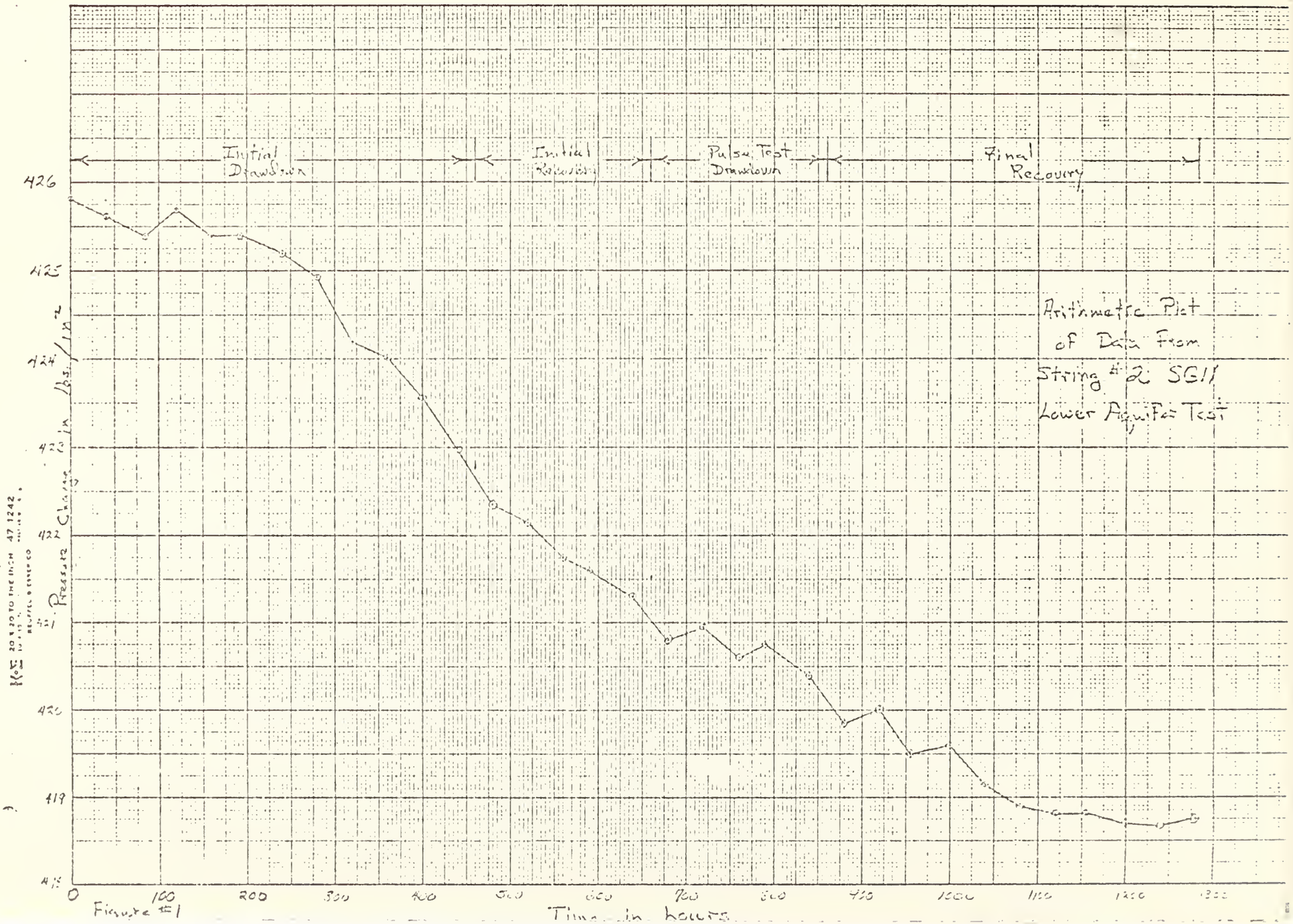
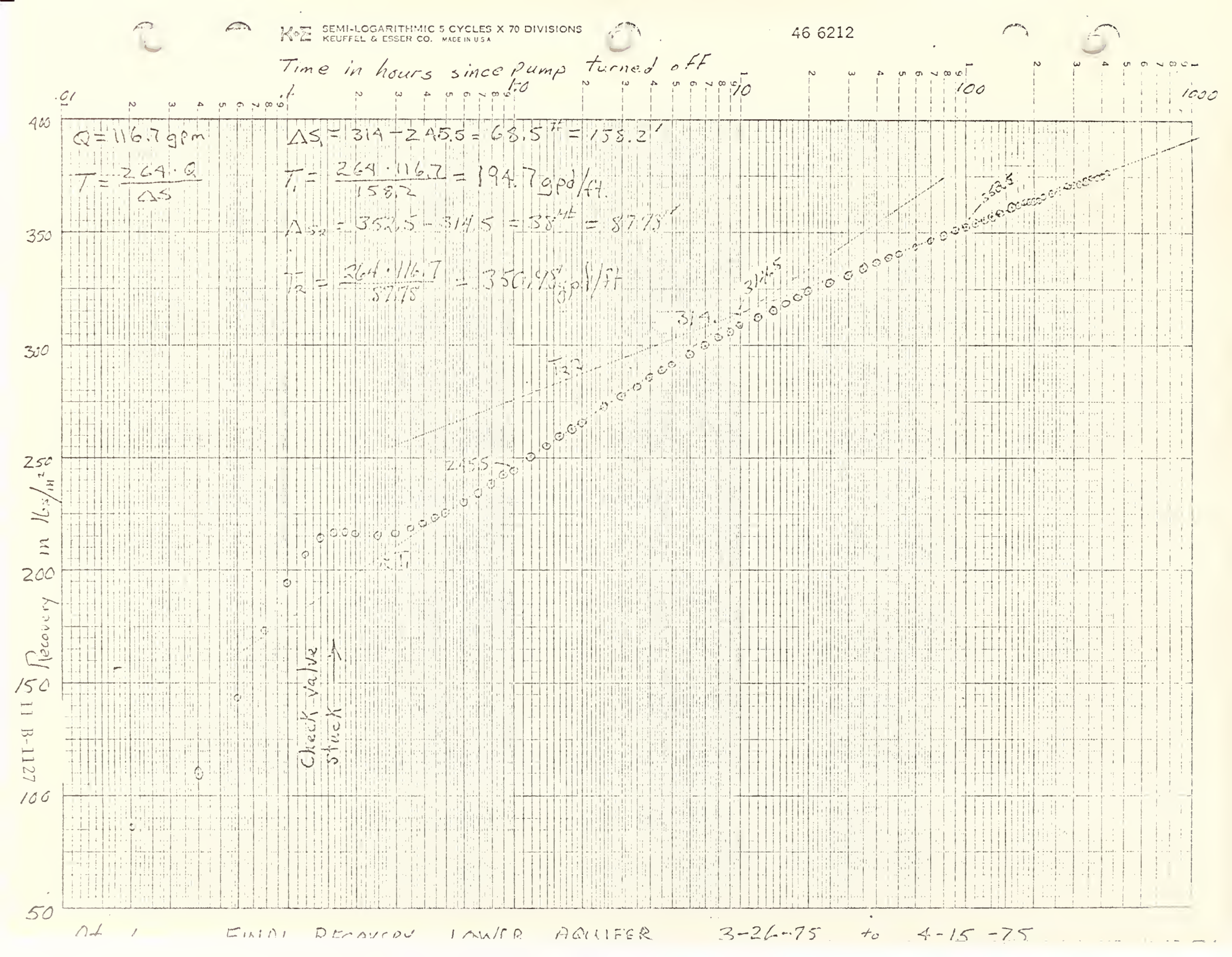

Initial Drawdown
Initial Recovery
Pulse Test Drawdown
Final Recovery
426
425
424
423
422
421
420
419
418
Pressure Change in lbs./in.²
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
Time in hours
Arithmetic Plot of Data from String #2 SGI Lower Aquifer Test

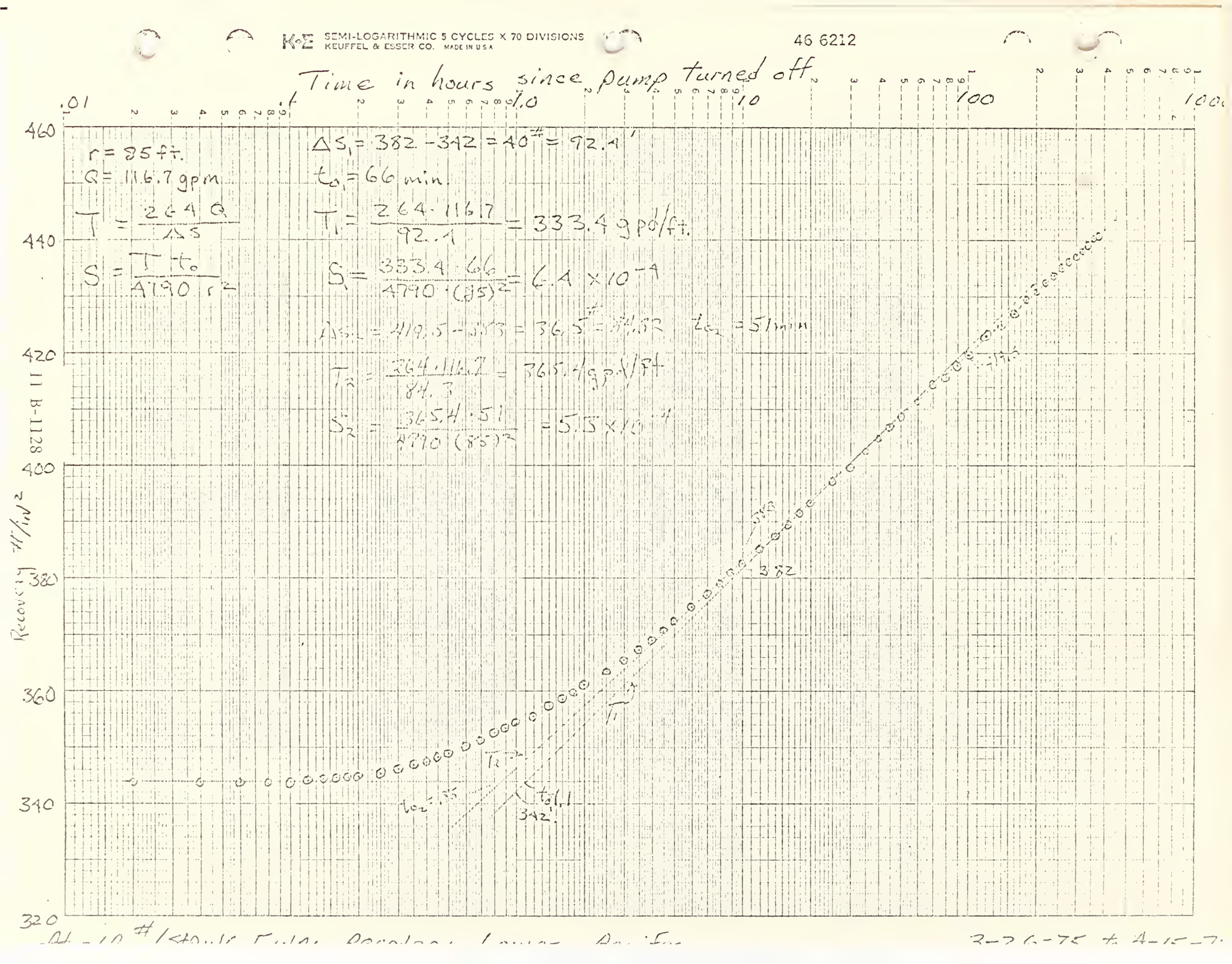
Figure #1

K&E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212

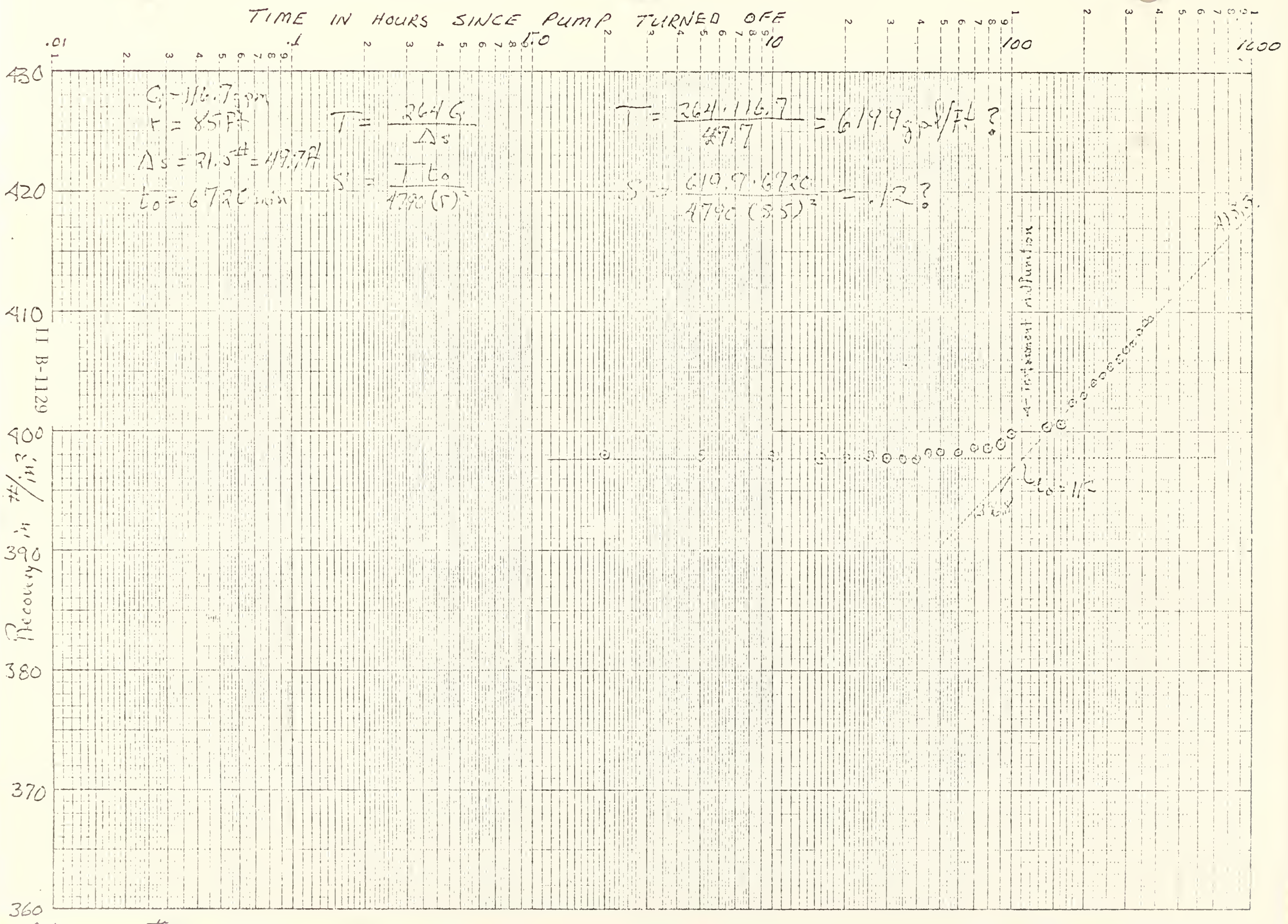


Ad 1 FINAL RECOVERY LOWER AQUIFER 3-26-75 to 4-15-75



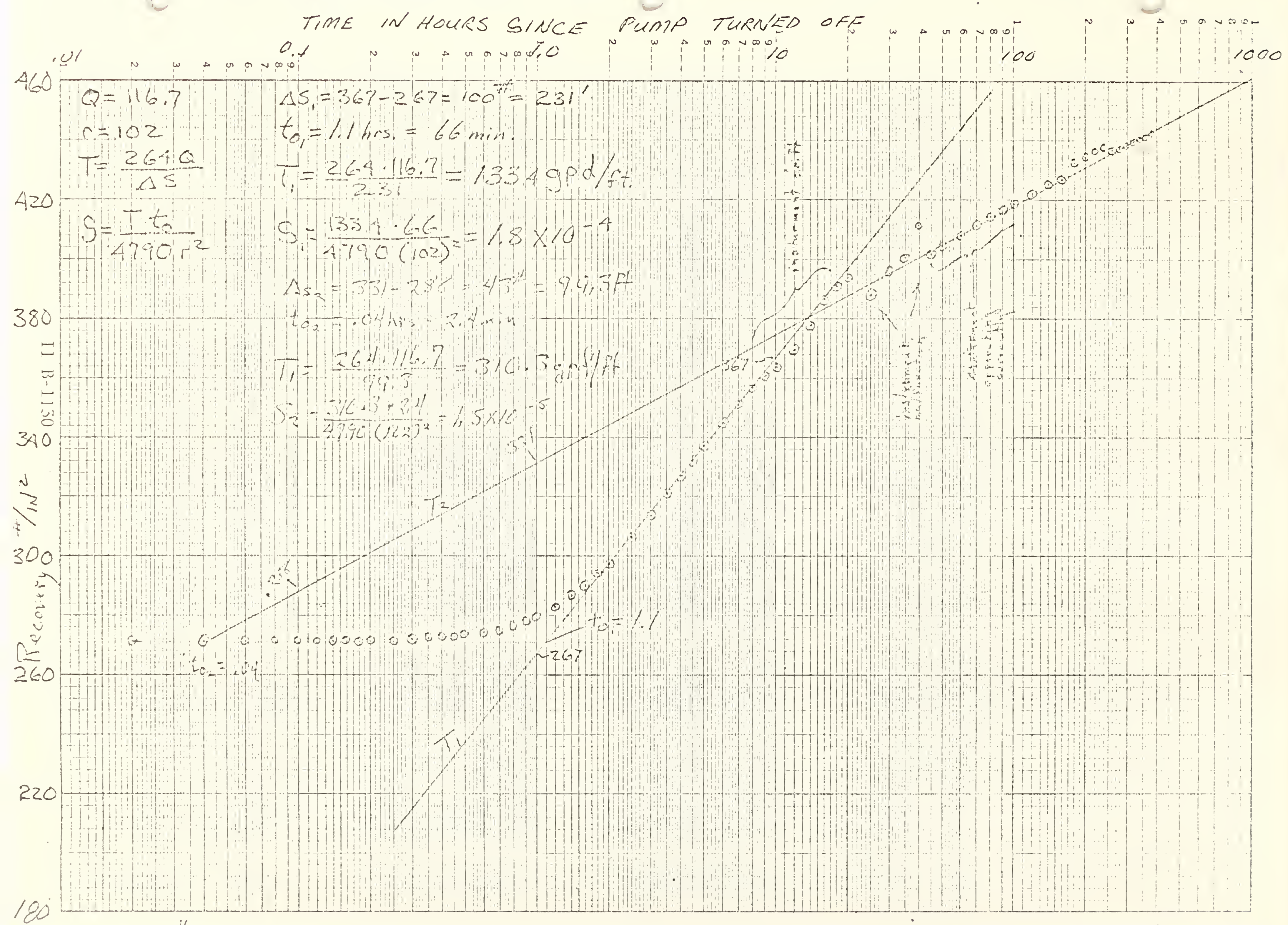
4-10 #/sq.in. Final Pressure Lower Basin

3-26-75 & 4-15-75

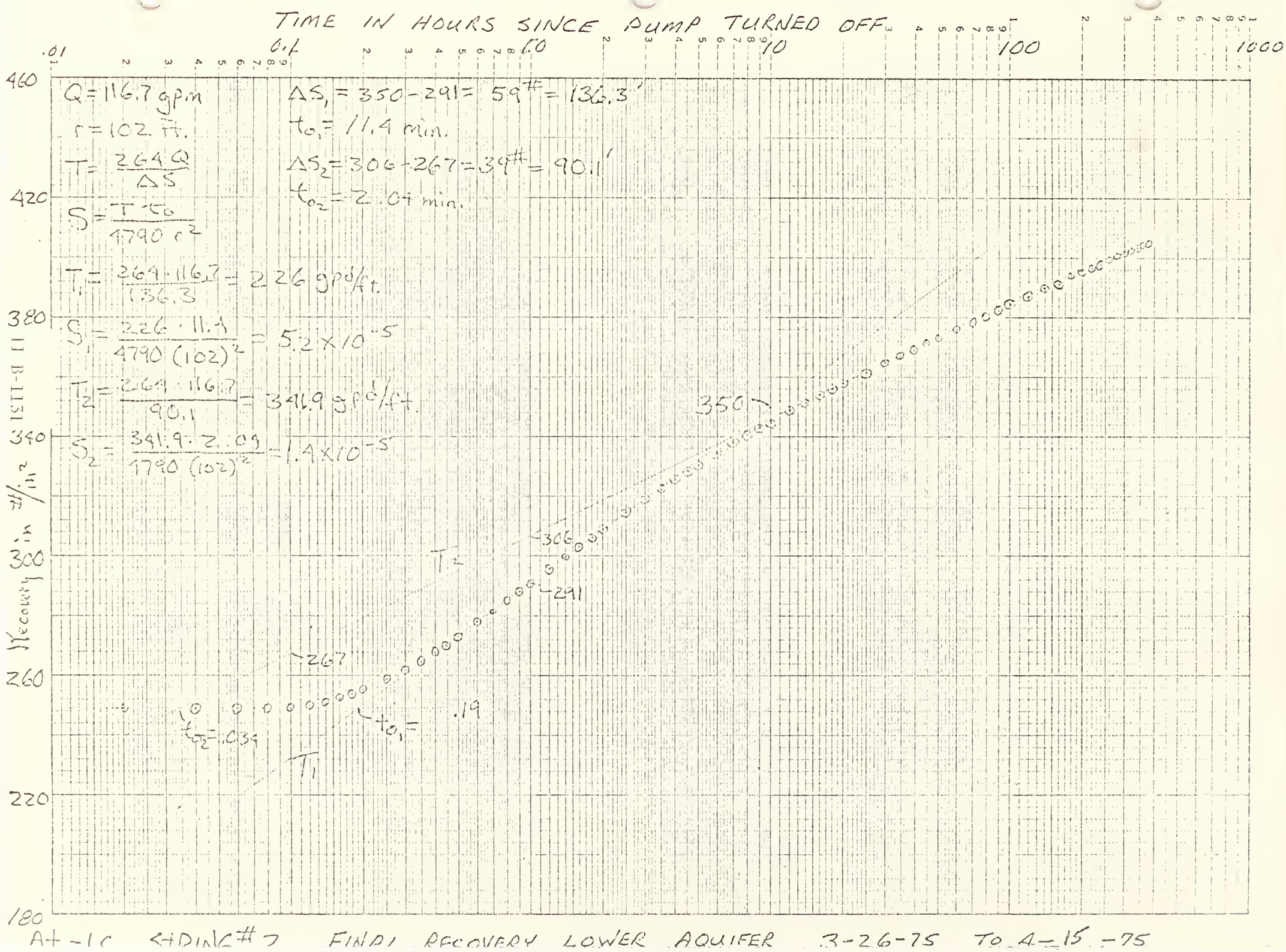


K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212



At-16 #1 STRING FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75



At-1C <4DING#7 FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75

SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212

TIME IN HOURS SINCE PUMP TURNED OFF

.01 .1 1.0 10 100 1000

480 440 400 360 320 280 240 200

Recovery in lbs/in² B-1132

$Q = 116.7$ gpm

$r = 127'$

$T = \frac{264\,Q}{\Delta s}$

$S = \frac{T\,t_o}{4790\,r^2}$

$\Delta s_1 = 344 - 300 = 44^{\#} = 101.6'$

$t_{o_1} = 6.3$ min.

$T_1 = \frac{264 \cdot 116.7}{101.6} = 303.2$ gpd/ft.

$S_1 = \frac{303.2\,6.3}{4790\,(127)^2} = 2.5 \times 10^{-5}$

$\Delta s_2 = 311 - 274 = 37^{\#} = 85.47'$

$t_{o_2} = .0375$ hrs $= 2.25$ min

$T_2 = \frac{364 \cdot 116.7}{85.47} = 366.5$ gpd/ft.

$S_2 = \frac{366.5 \cdot 2.25}{4790\,(127)^2} = 1.7 \times 10^{-5}$

$t_{o_2} = .0375$

$t_{o_1} = .105$

311

300

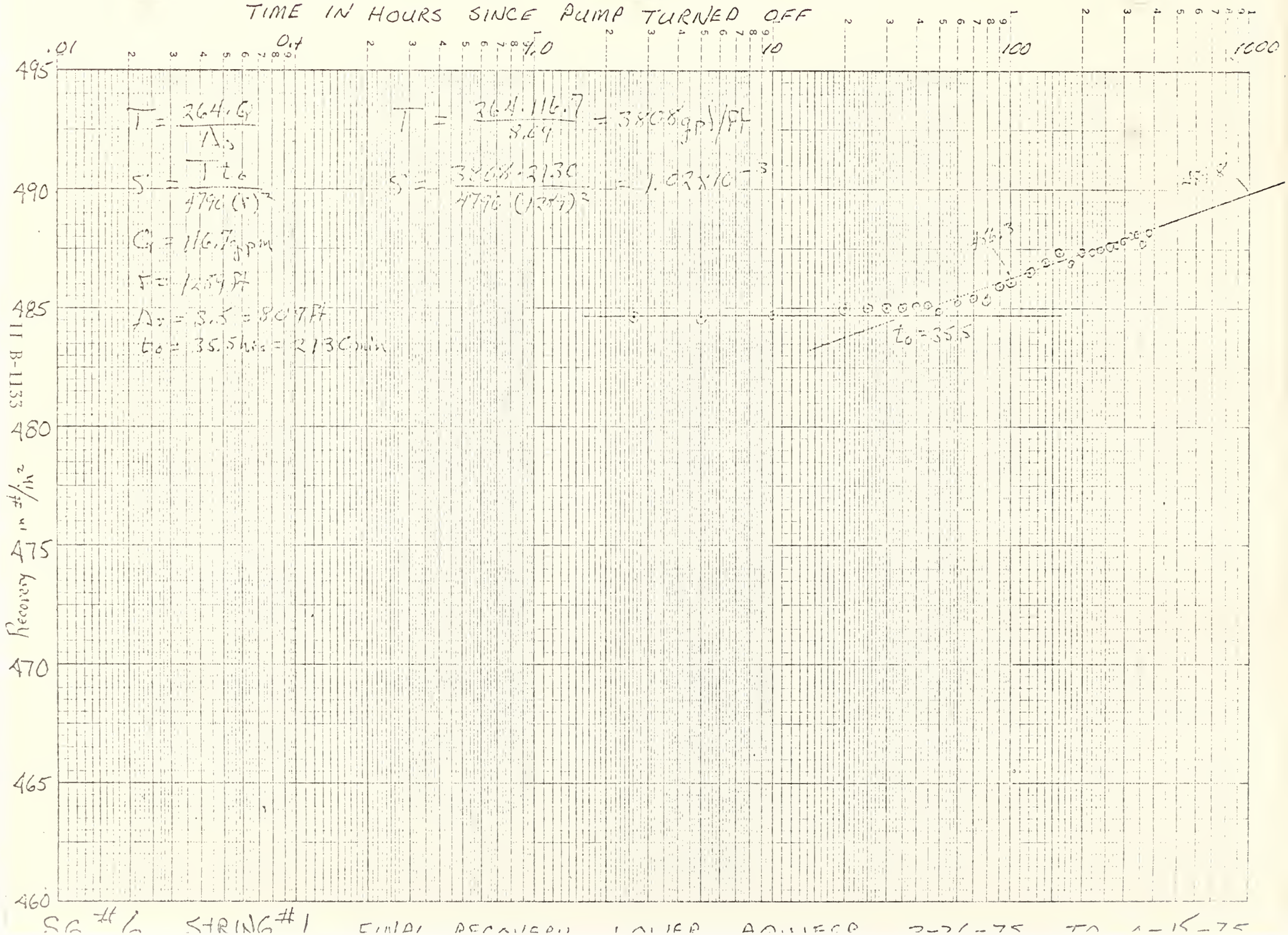
274

T_2

T_1

At -10 string #3 FINAL RECOVERY DATA TAKEN 3-27-75 TO 4-15-75

46 6212



SG #6 STRING #1 FINAL RECOVERY LOWER ROMECO 7-24-75 TO 1-15-75

46 6212

TIME IN HOURS SINCE PUMP TURNED OFF

$Q = 116.7$ gpm
$r = 1789$ ft
$T = \frac{264 \cdot Q}{\Delta s}$
$S = \frac{T t_o}{1790 (r)^2}$
$\Delta s = 423.5 - 346.5 = 33.5^{ft} = 76.92$ ft
$t_o = 36.5$ hrs $= 1.5^{day}$ min

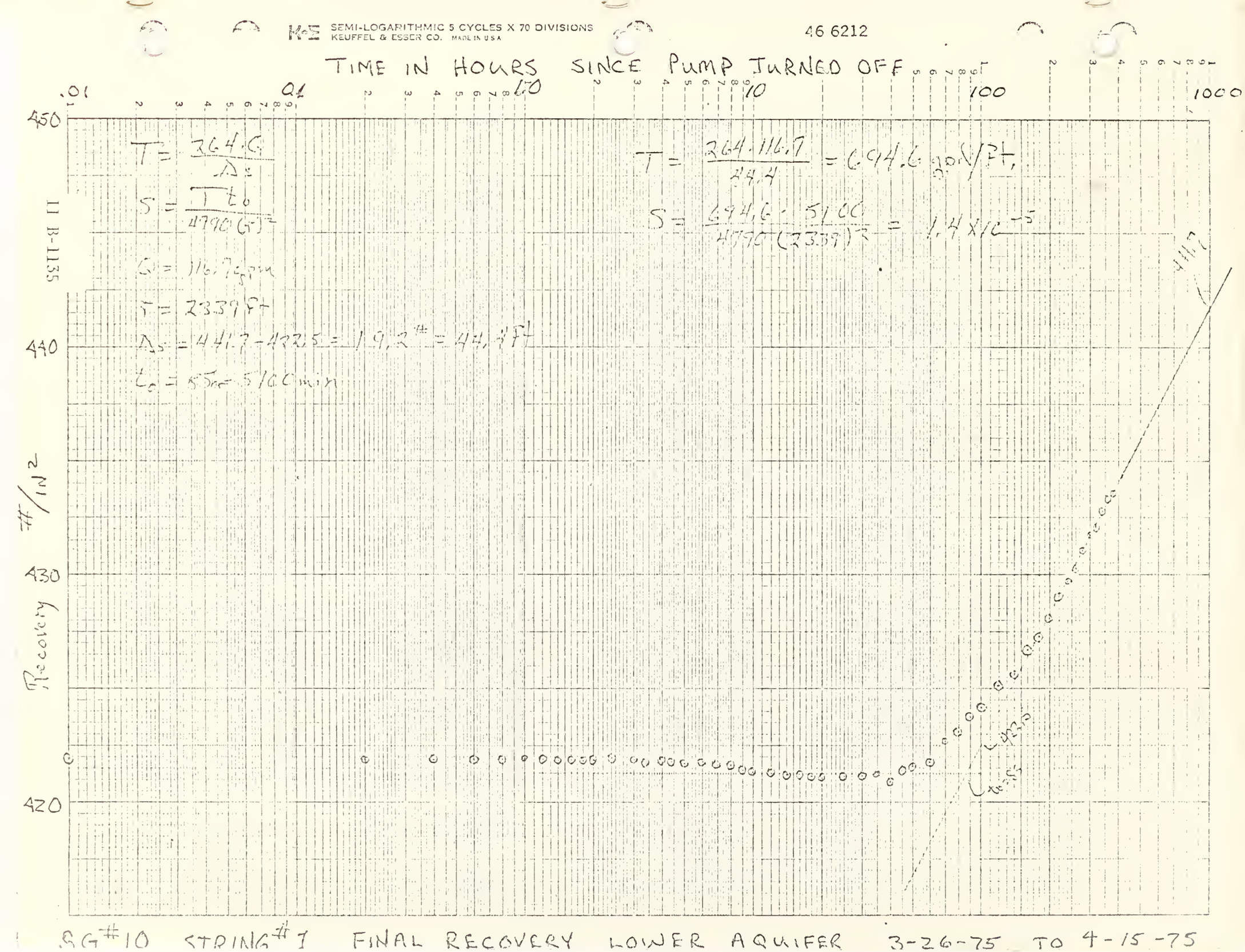
$T = \frac{264 \cdot 116.7}{76.92} = 400.5$ gpd/ft

$S = \frac{400.5 \cdot 1.5}{1790 (1789)^2} = 8 \times 10^{-5}$

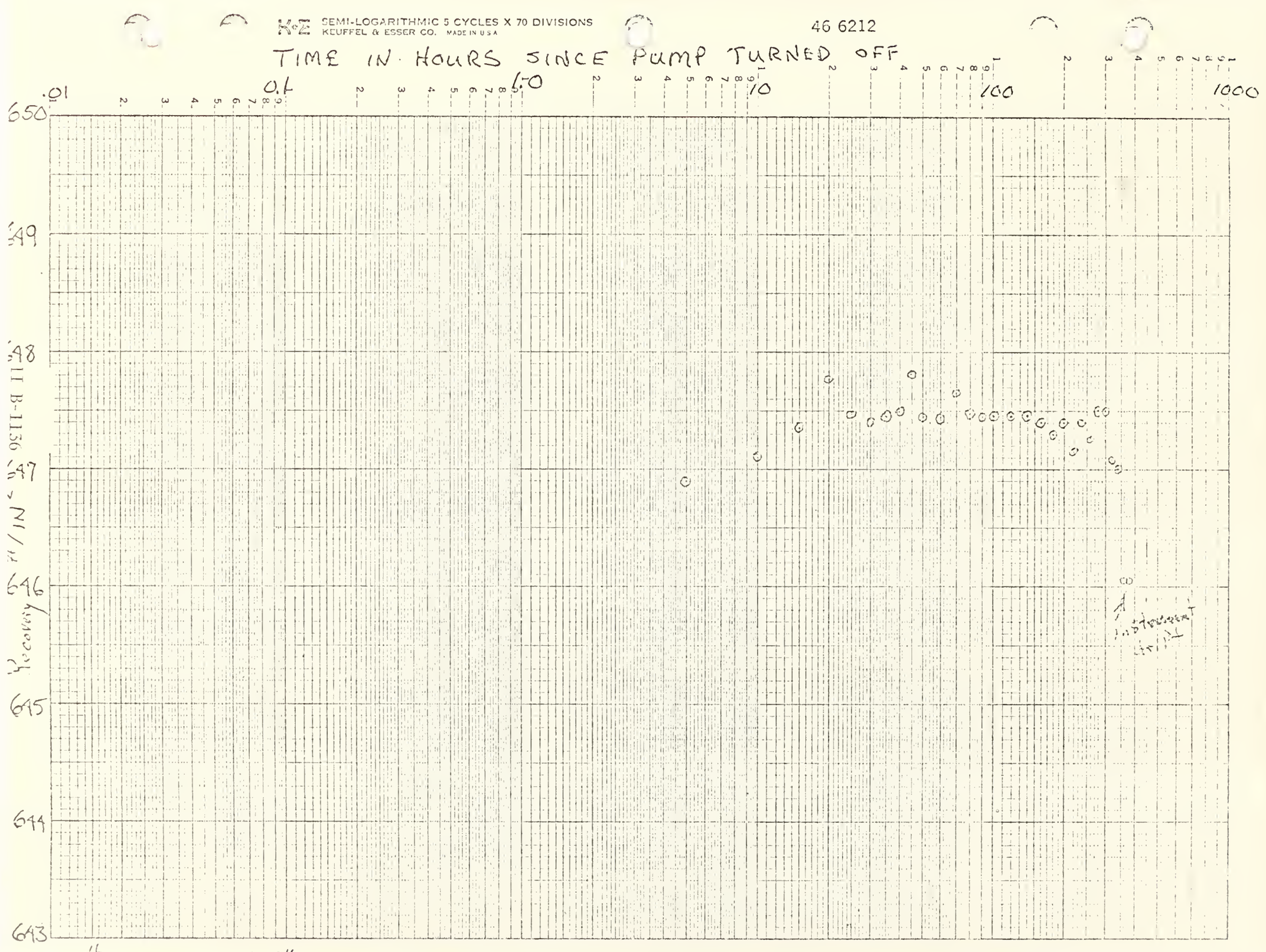
$t_o = 36.5$

OBS. WELL #1 STRING #2 FINAL RECOVERY LOWER AQUIFER: 2 26-75 TO 1 15-75

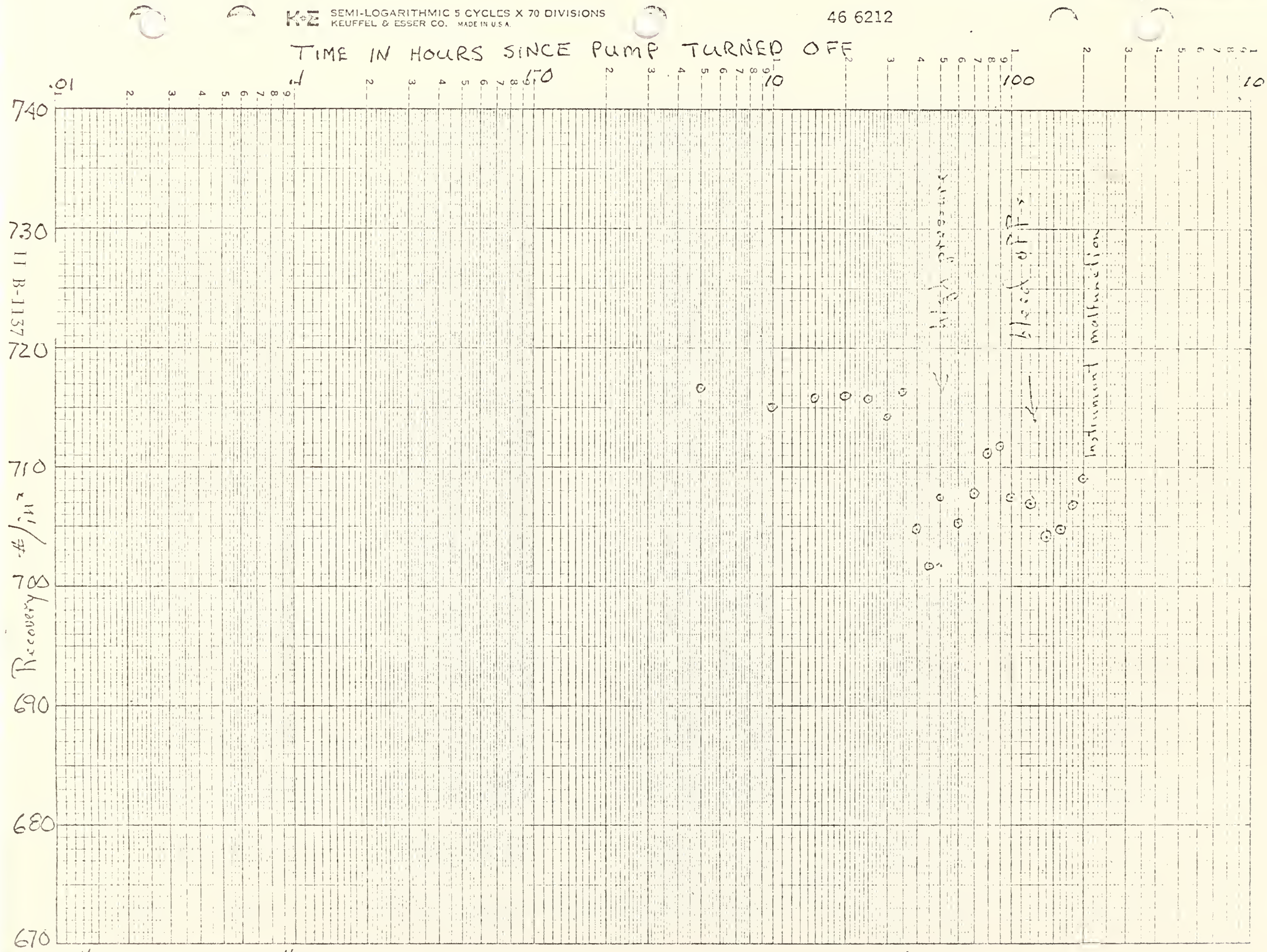
46 6212



RG#10 STRING#1 FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75



CP #1A <TRIAL #> FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75



II B-1137

SC #11 STRING #1 FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-7

46 6212

TIME IN HOURS SINCE PUMP TURNED OFF

.01 .1 1.0 10 100

426
425
424
423
422
421
420
419

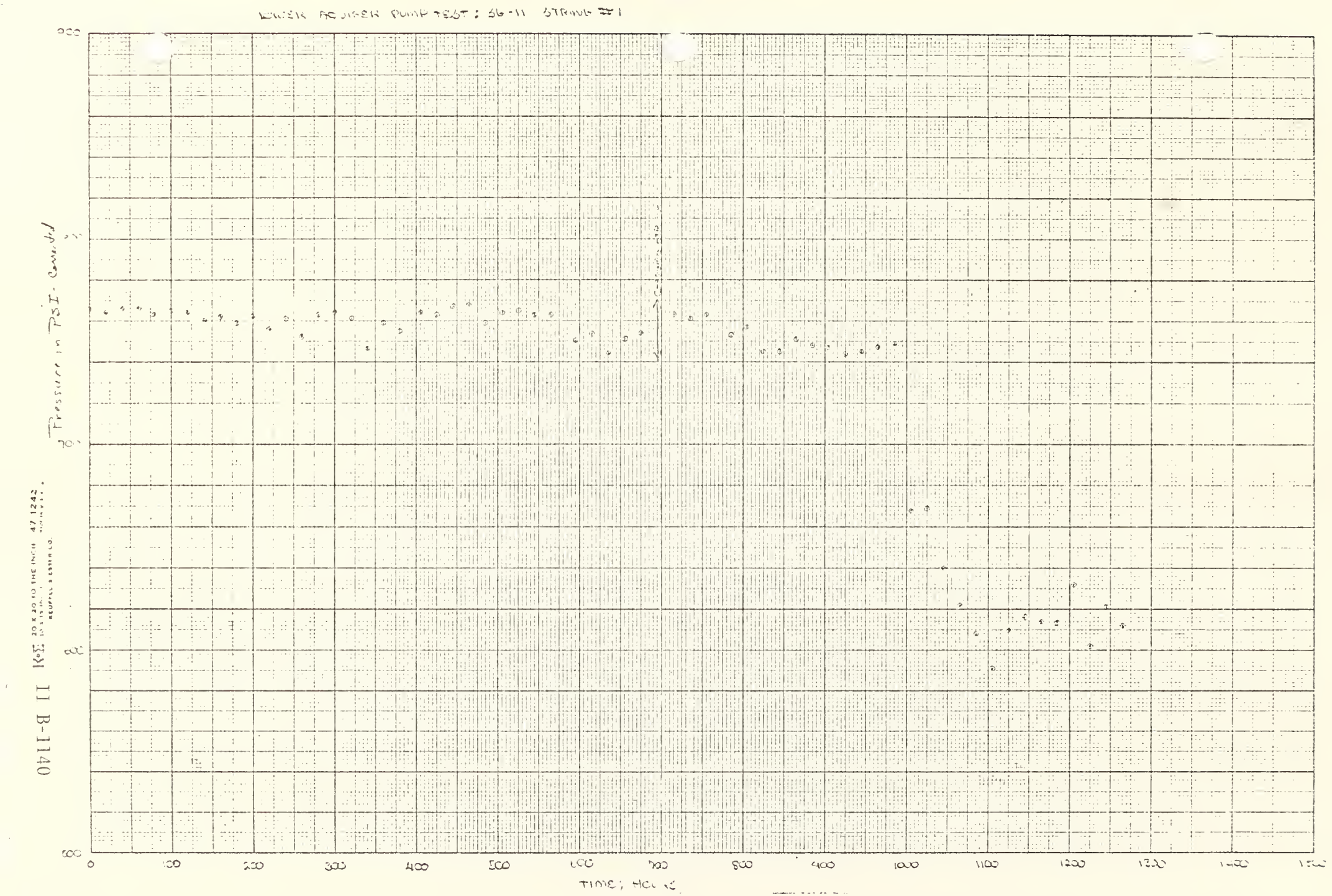
II B-1158

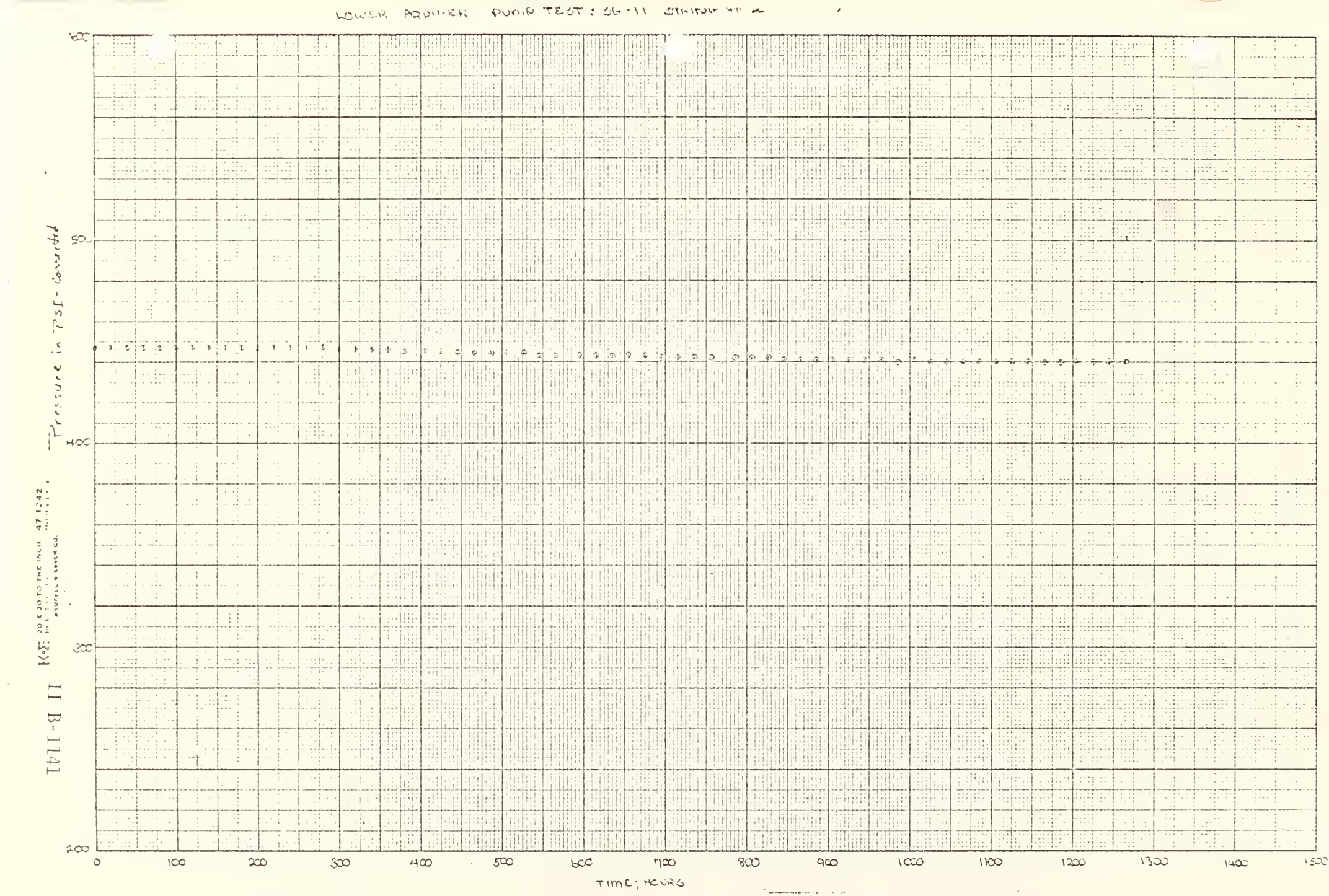
Instrument drift

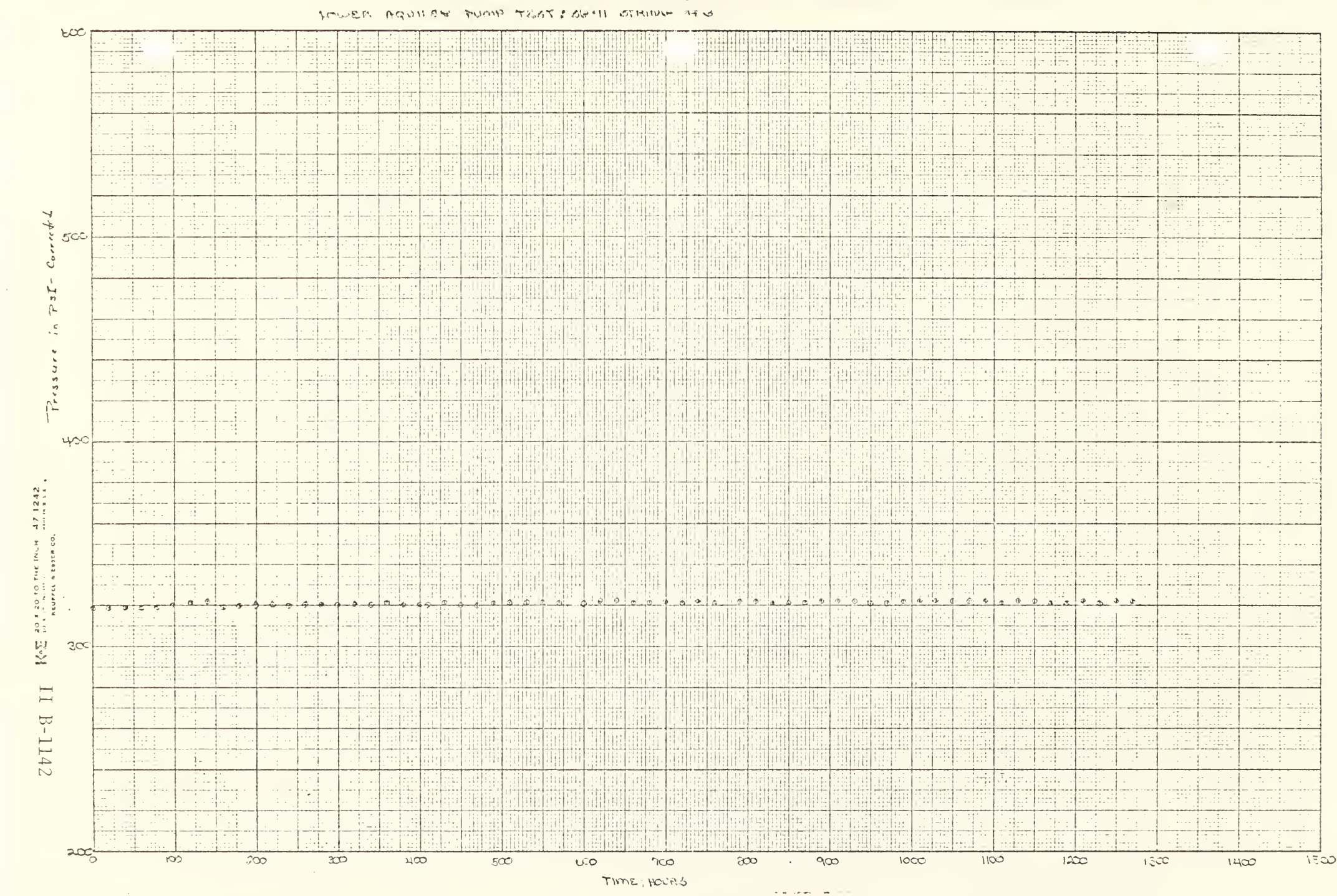
SC #11 STRING #2 FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75

LOWER AQUIFER PUMP TEST

CORRECTED PRESSURE CURVES

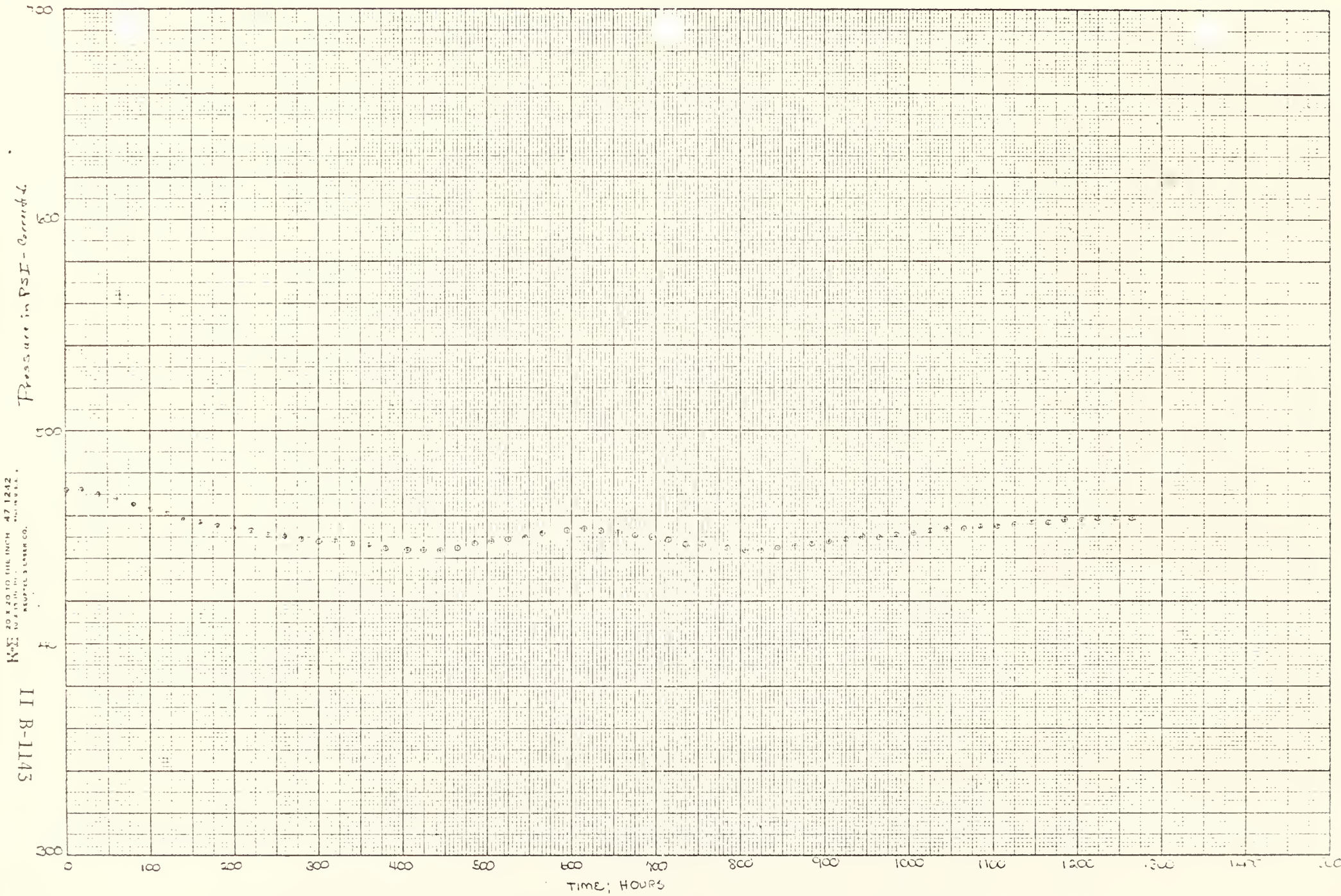

LOWER ROUSER PUMP TEST : 56-11 STRAW #1
Pressure in PSI - Corrected
TIME; HOURS
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
500
600
700
800
900
KEUFFEL & ESSER CO.
20 X 20 TO THE INCH 47 1242
B-1140

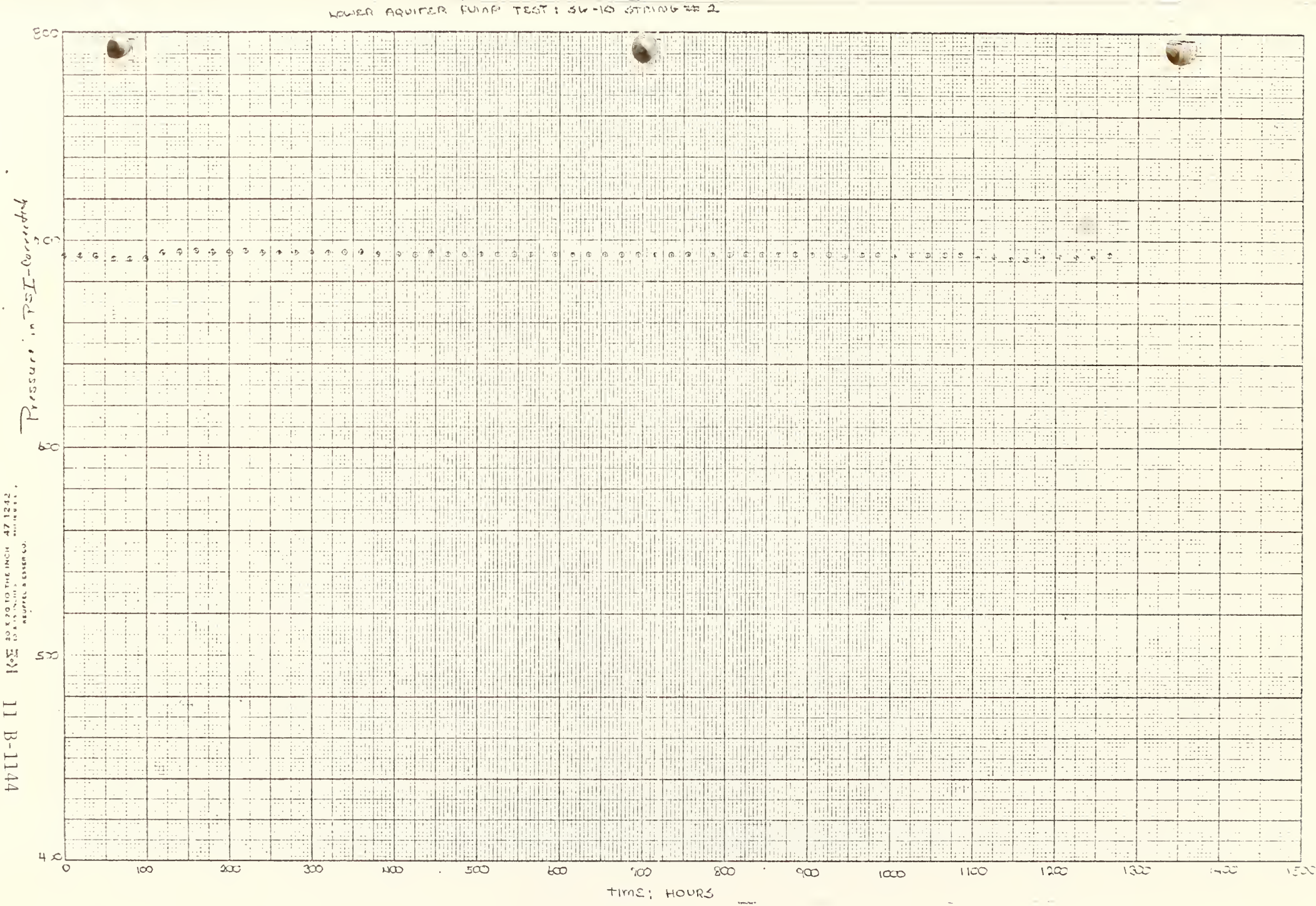

LOWER AQUIFER PUMP TEST : 86-11 STATION #2
Pressure in PSI - corrected
60
50
40
30
20
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
TIME; HOURS
II B-1141


Pressure in PSI- Corrected
600
500
400
300
200
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
TIME; HOURS

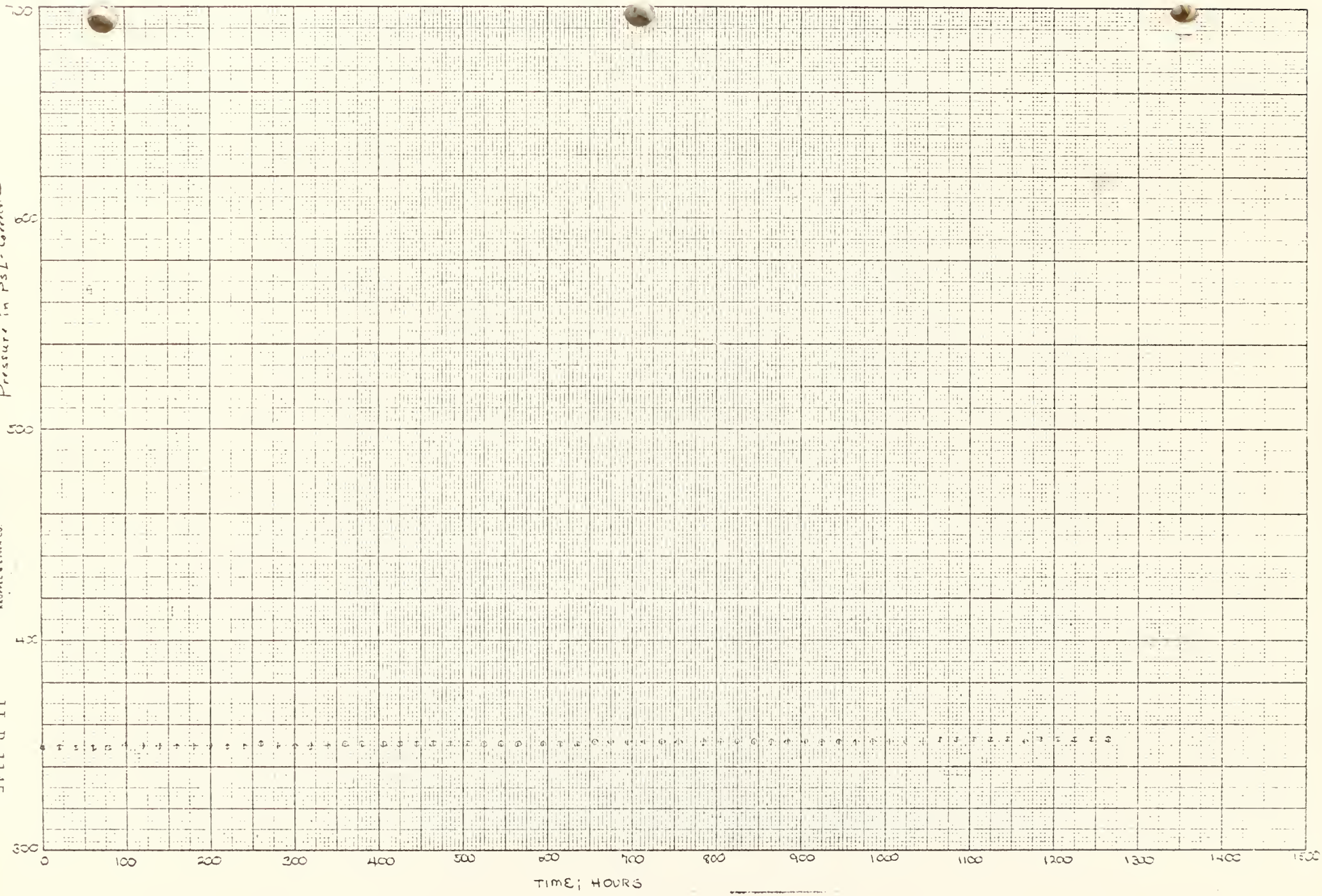
II B-1142

LOWER AQUIFER PUMP TEST : 96-10 MT KING #1

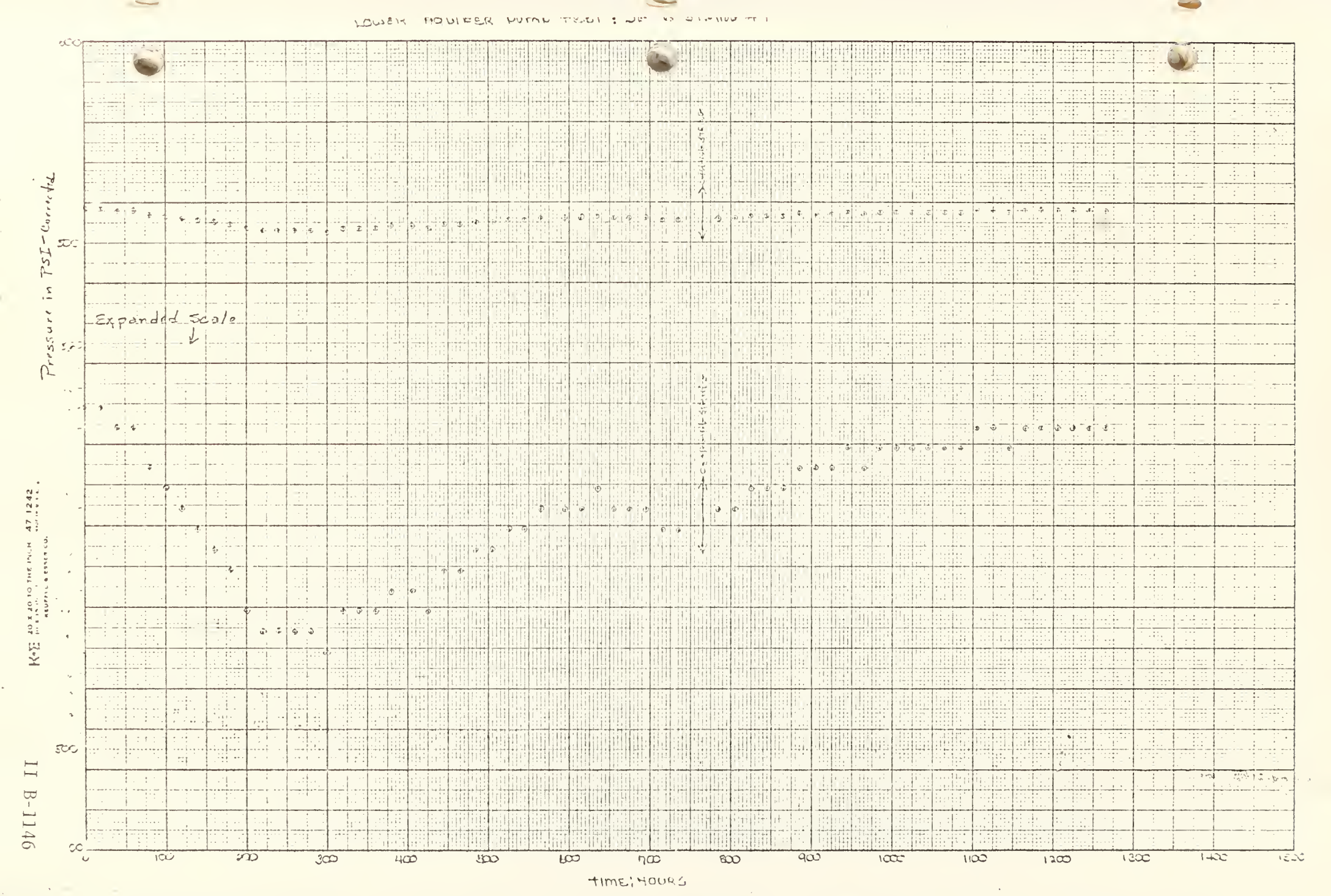


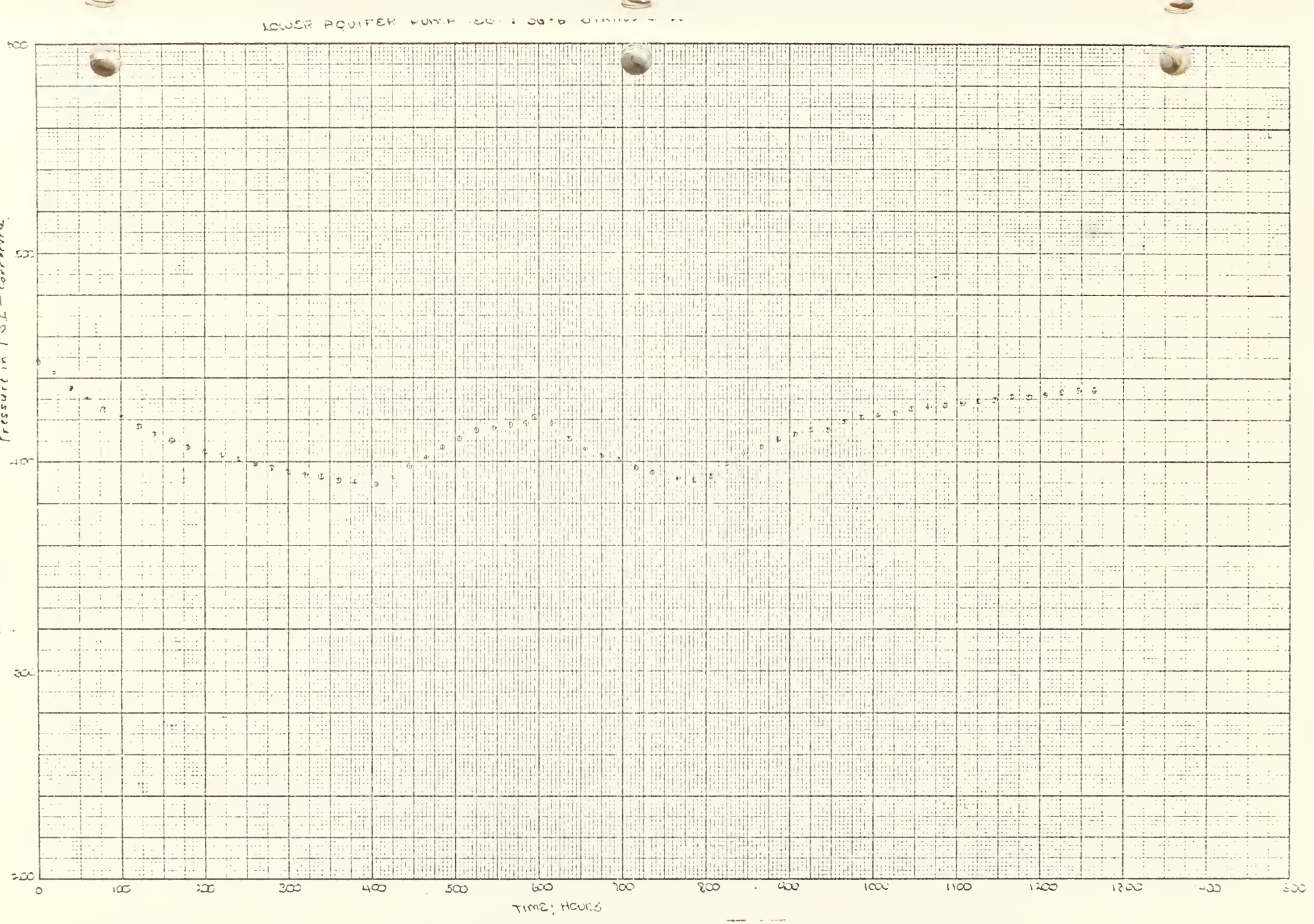


LOWER AQUIFER PUMP TEST: SG-10 SPRING #3



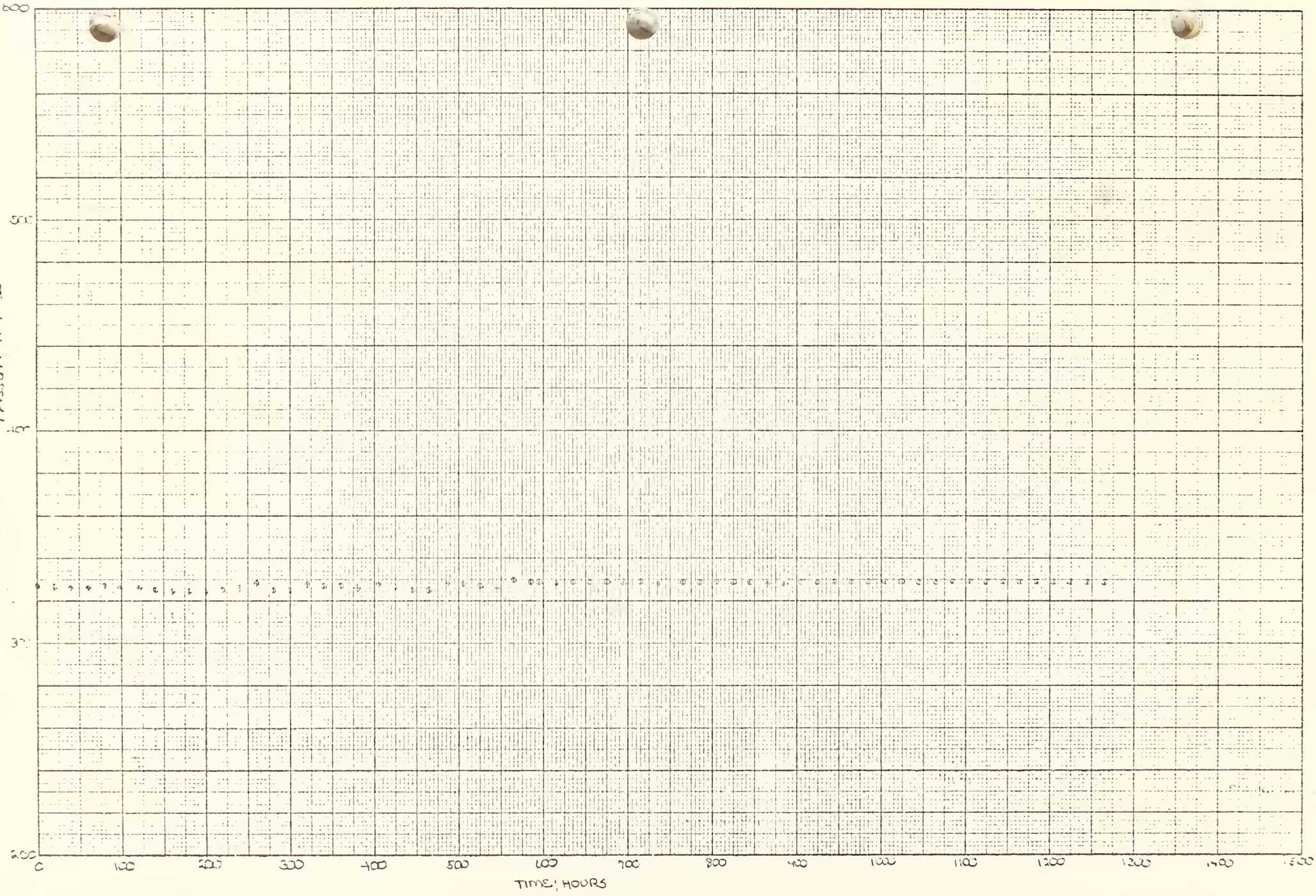
II B-1145


Pressure in PSI - Corrected
Expanded Scale
TIME; HOURS
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
500


LOWER AQUIFER PUMP
Pressure in PSI - corrected
80
60
40
20
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
TIME, HOURS

II B-1147

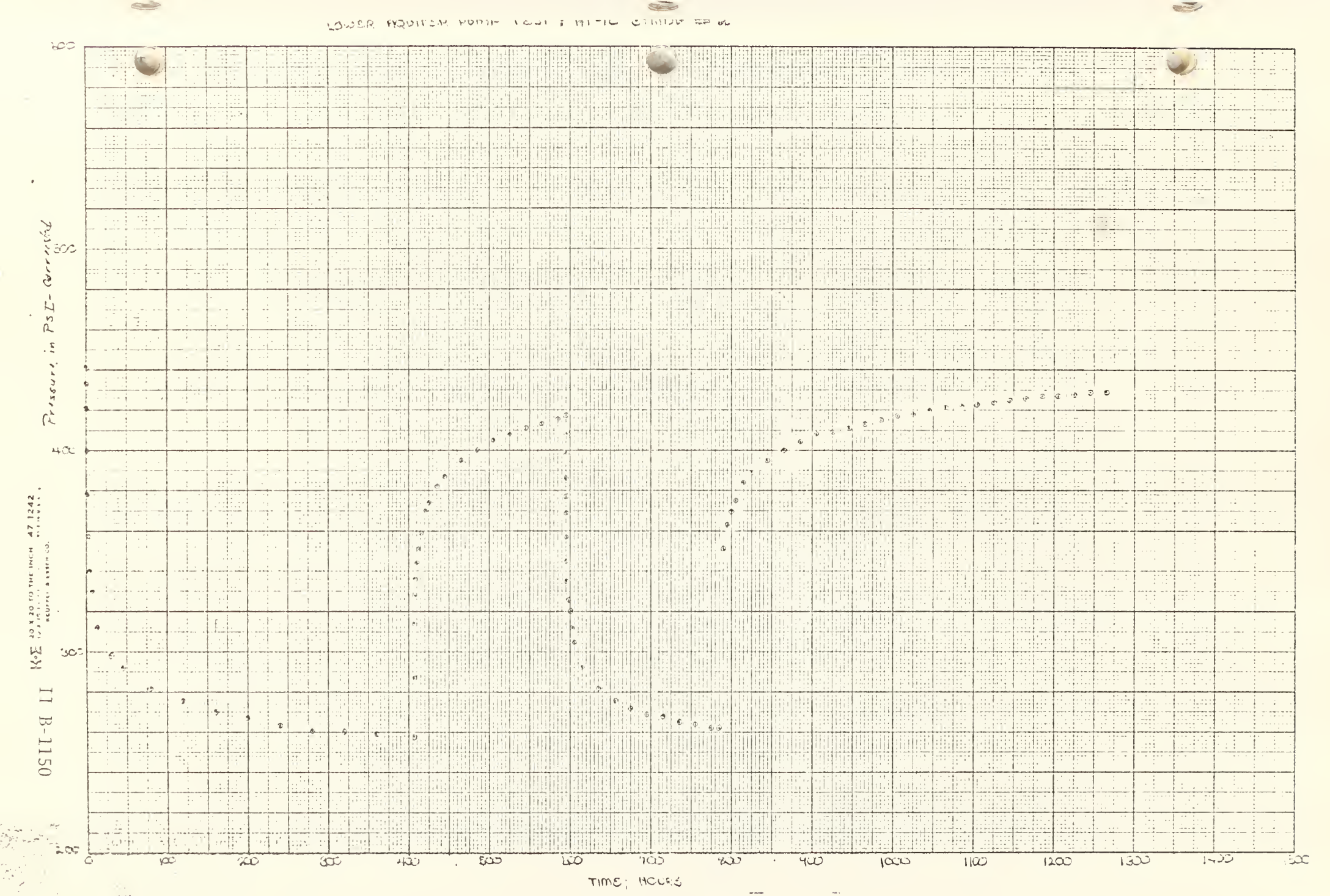
LOWER AQUIFER PUMP TEST: 56-6 STRING #3

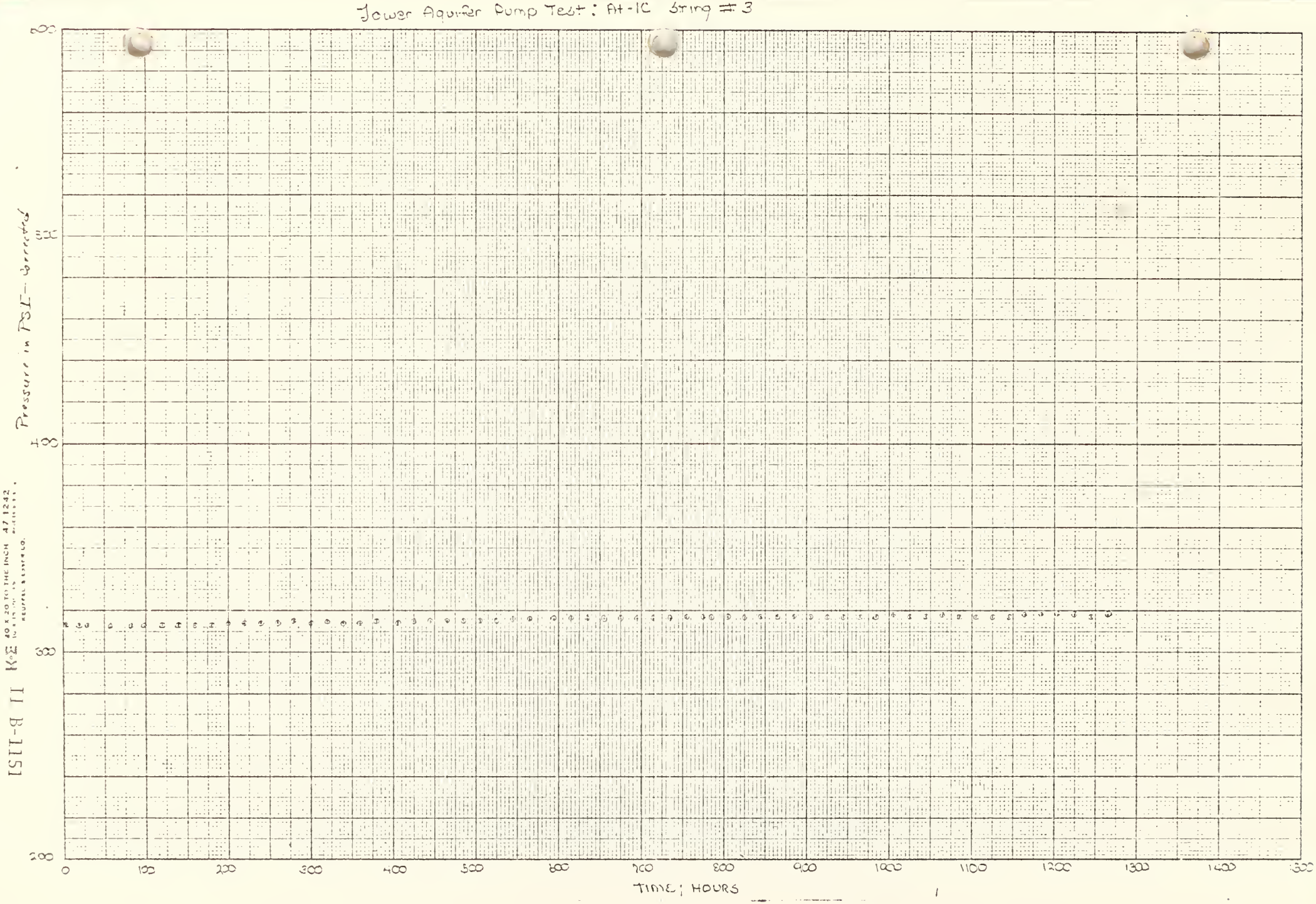


II B-1148

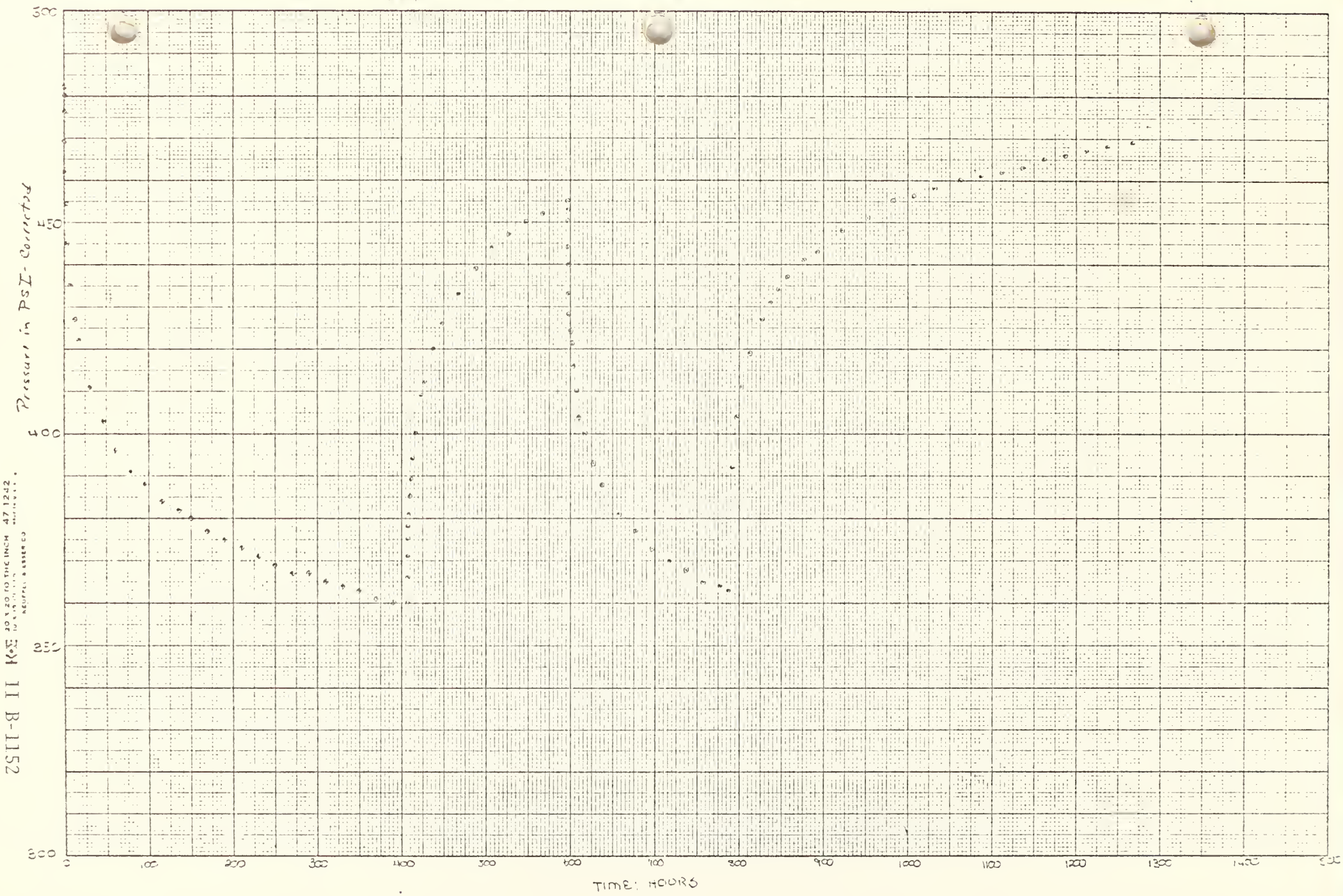
Pressure in psia - corrected
TIME, HOURS
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
2000
3000
4000
5000
6000

II B-1149


Pressure, in PSI-Gauge
TIME; HOURS
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
80
60
40
20
KE 10 X 10 TO THE INCH 47 1242
II B-1150


Lower Aquifer Pump Test: At-1C String #3
Pressure in PSI- Corrected
TIME; HOURS
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
200
300
400
500
KEUFFEL & ESSER CO. 20 X 20 TO THE INCH 47 1242
B-1151

LOWER AQUIFER PUMP TEST: PW-1A OTHINK #1

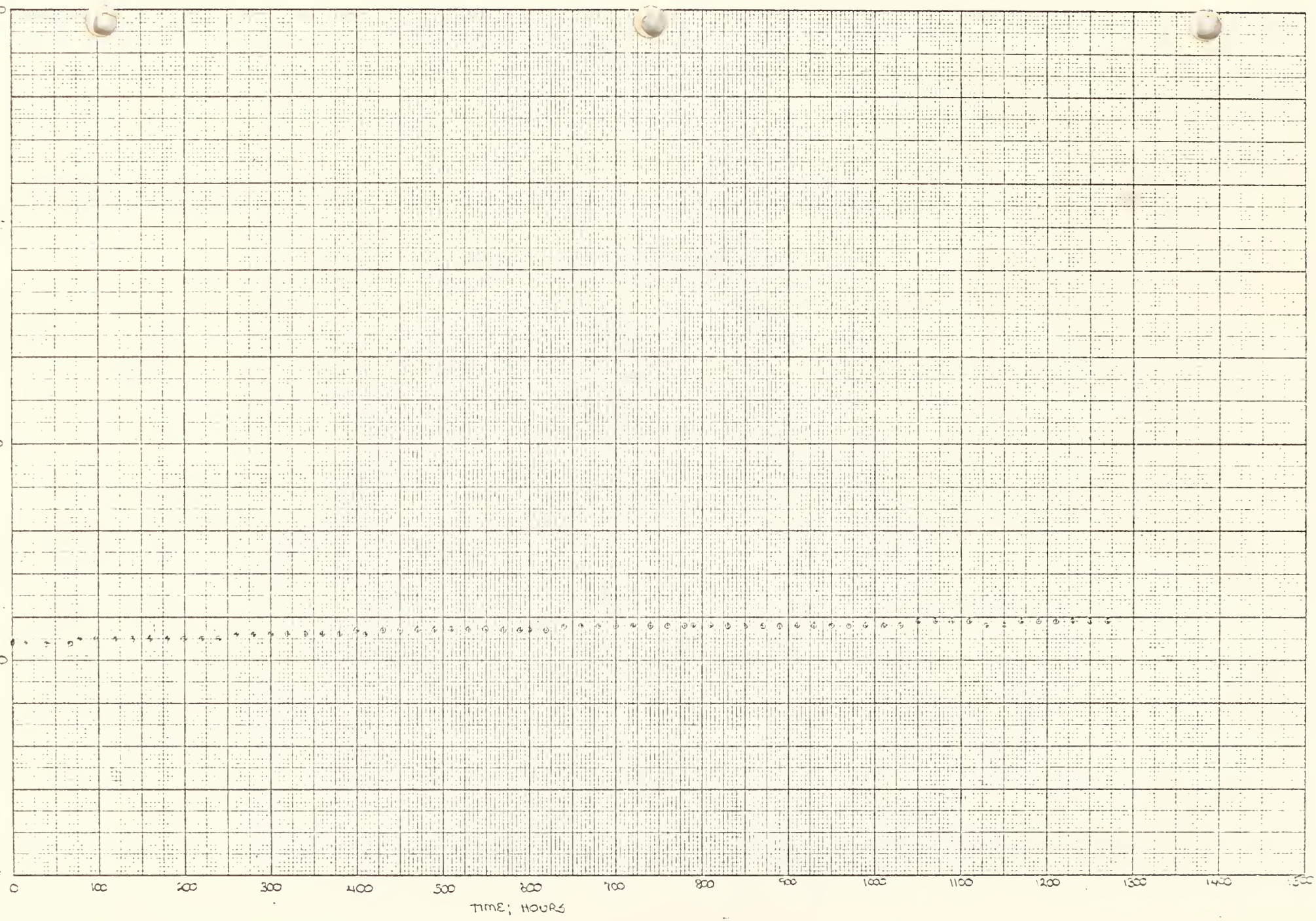


EM 11 B-1152

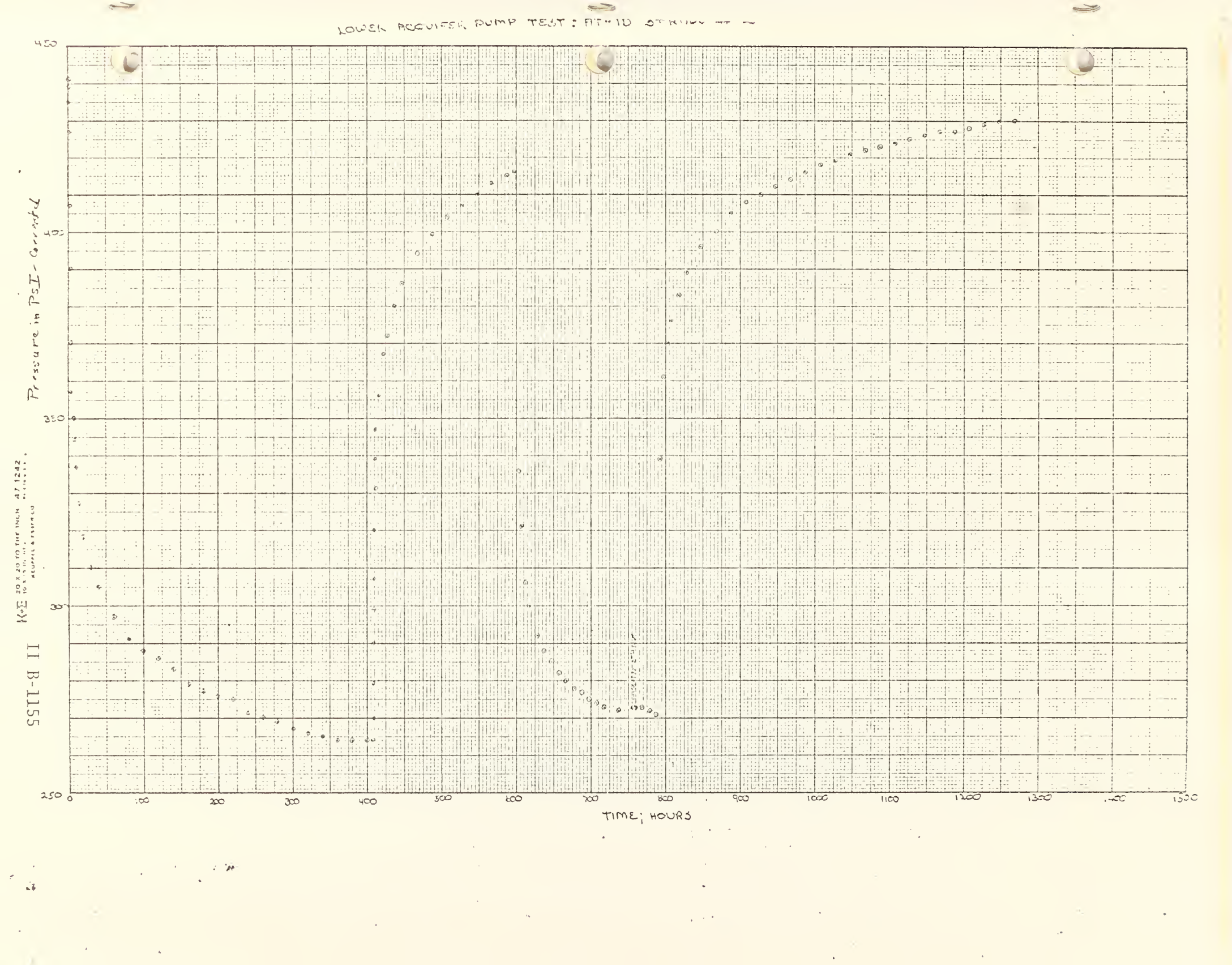
TIME, HOURS
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500

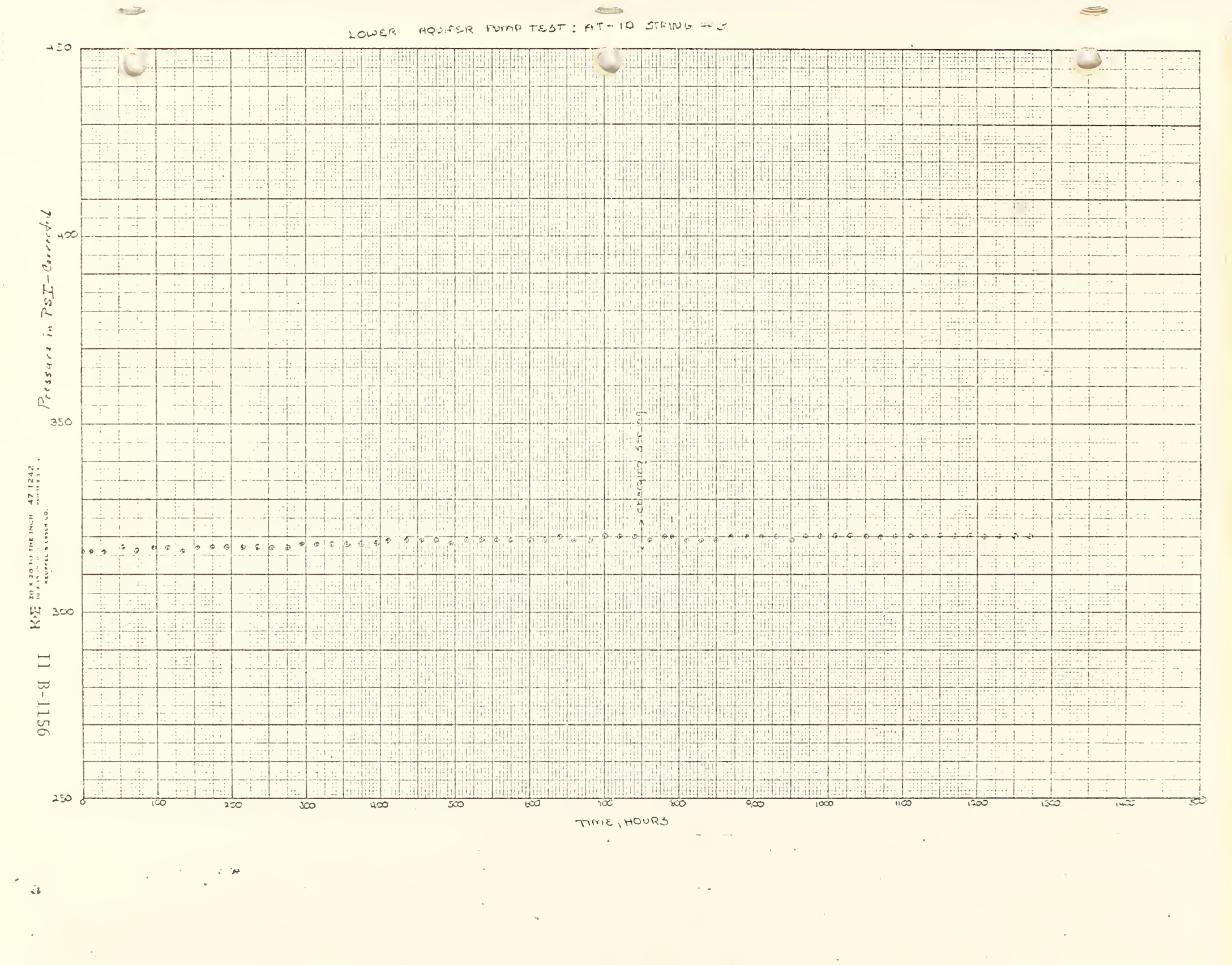
II B-1153

LOWER AQUIFER PUMP TEST: AT-1A STRING #3

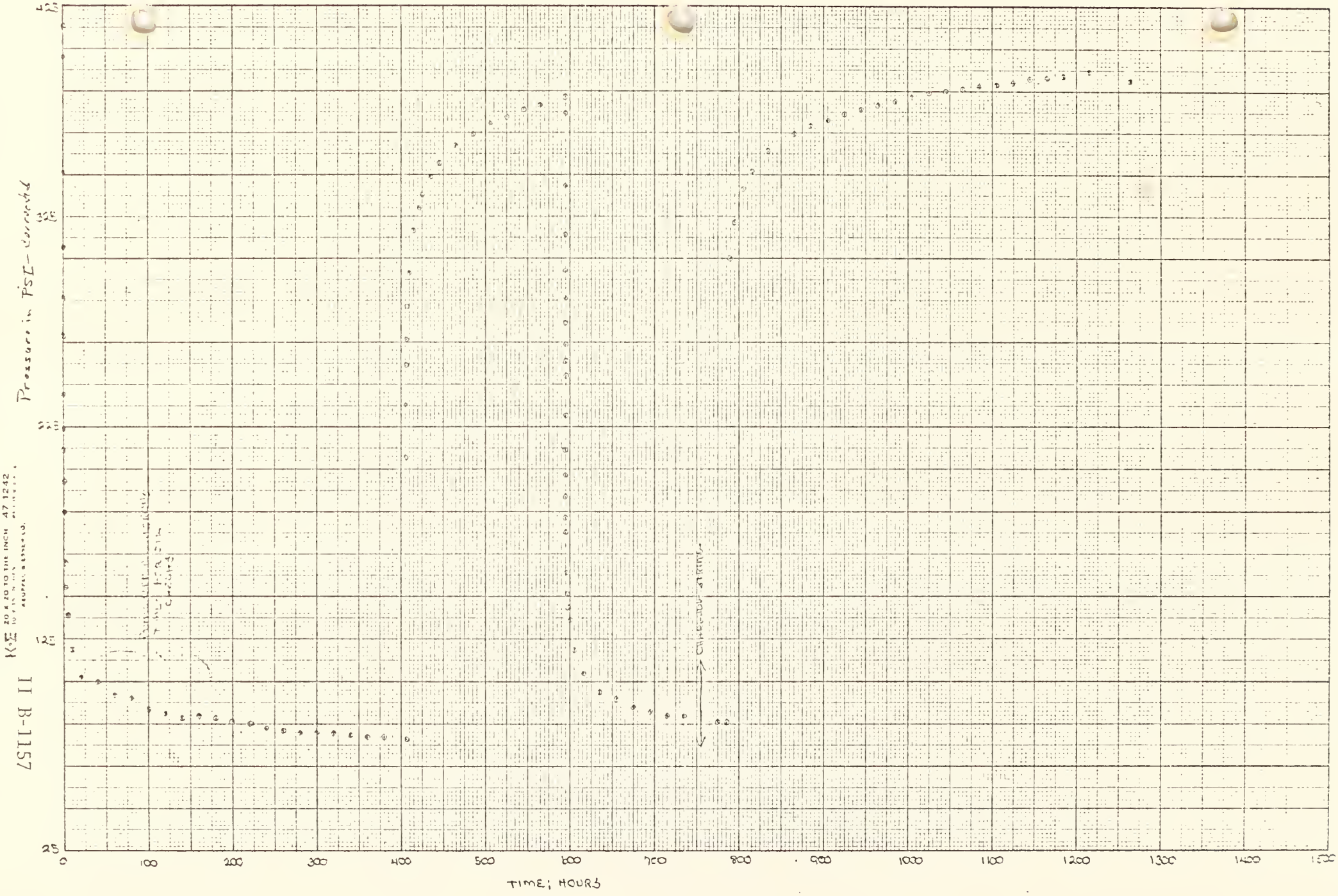


II B-1154


LOWER AQUIFER PUMP TEST : AT-10 STRIDE #
Pressure in PSI - Corrected
450
400
350
300
250
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
TIME; HOURS
KOE 20 X 20 TO THE INCH 47 1242
II B-1155


LOWER AQUIFER PUMP TEST : AT-10 STRING #2
Pressure in PSI-Corrected
TIME, HOURS
350
300
250
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
K&E 20 X 20 TO THE INCH 47 1242
B-1156 II

LOWER AQUIFER TEST / MT-1



II B-1157

AQUIFER DATA

ALLUVIAL WELL PUMP TEST

TABLE II B-55

ALLUVIAL WELL A#1 PRODUCTION 6.11 gpm
Measured 4-23-75 Starting 1129 hours
Static Water Level 46.82 ft.

Drawdown		Recovery	
Column #1	Column #2	Column #1	Column #2
time of measurement from 0 = 1129 hours + minutes	drawdown in feet (-) from 0 = 46.82 feet below land surface	time of measurement from 0 = 1309 hours + minutes	recovery in feet (-) from 0 = 46.82 feet below land surface
0	0	0	0
1	0.59	1	.55
2	0.63	2	.62
3	0.675	3	.66
4	0.70	4	.68
5	0.705	5	.70
6	0.715	6	.71
7	0.730	7	.71
8	0.730	8	.72
9	0.730	9	.72
10	0.725	10	.725
12	0.735	12	.73
14	0.740	14	.74
16	0.745	16	.75
18	0.745	18	.75
20	0.745	20	.76
25	0.745	25	.76
30	0.750	30	.76
35	0.750	35	.76
40	0.755	40	.765
45	0.755	45	.77
50	0.755	50	.77
60	0.755	60	.77
70	0.760	70	.77
80	0.765	80	.77
90	0.760	90	.77
100	0.762		
120	0.760		
140	0.760		
160	0.760		
180	0.750		
temperature 12.5°C	conductivity 2200 ohms		

TABLE II B-56

ALLUVIAL WELL A#2 PRODUCTION 6.11 gpm
Measured 4-14-75 Starting 13:05 hours
Static Water Level 14.06 ft.

Drawdown		Recovery	
Column #1	Column #2	Column #1	Column #2
time of measurement from 0 = 13:05 hours + minutes	drawdown in feet (-) from 0 = 14.06 feet below land surface	time of measurement from 15:45 hours + minutes	recovery in feet (-) from 0 = 14.06 feet below land surface
0	0	0	5.72
1	2.8	1	3.0
2	3.25	2	2.15
3	3.7	3	1.79
4	3.93	4	1.59
5	4.03	5	1.40
6	4.15	6	1.27
7	4.29	7	1.16
8	4.37	8	1.18
9	4.47	9	1.12
10	4.56	10	.95
12	4.77	12	.83
14	4.94	14	.75
16	5.04	16	.69
18	5.12	18	.63
20	5.20	20	.58
25	5.28	25	.48
30	5.41	30	.40
35	5.47	35	.33
40	5.55	40	.28
45	5.60	45	.25
50	5.60	50	.21
60	5.58	60	.15
70	5.67	70	.10
80	5.68	80	.05
90	5.69	90	.05
100	5.69	100	.01
120	5.72	120	-.03
140	5.74	140	-.05
160	5.76	160	-.07
180	5.72	180	-.09
200	5.67	200	-.10
220	5.67	220	-.11
240	5.72	240	-.12
average temperature 11.0°C	average conductivity 1300 ohms		

TABLE II B-57

ANALYTICAL SUMMARY

ALLUVIAL WELLS

#A1 -	Drawdown (late data)	T =	67,210	gpd/ft.
	Recovery (early data)	T =	10,082	gpd/ft.
#A2 -	Drawdown (early data)	T =	881	gpd/ft.
	Recovery (late data)	T =	2,688	gpd/ft.

The range between early and late data analyses is the result of hole effects on the early data in general; the late data of these analyses will be the figure used.

K&E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO MADE IN U.S.A.

46 5493

A-1 DRAWDOWN APRIL 23, 1975

$T = \frac{264Q}{\Delta s}$ $Q = 6.11$ gpm

$\Delta s = .762 - .738 = .024$

$T = \frac{264(6.11)}{.024} = 67210$ gpd/ft

.738

.762

DRAWDOWN IN FEET

1.1
1.0
0.9
0.8
0.7
0.6
0.5

0.1 10 100 1000

G-1162 B-11

K&E SEMI-LOGARITHMIC 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 5493

A-1 Recovery April 23, 1975

$t = \frac{264\,Q}{\Delta S}$

$Q = 6.11$ gpm

$\Delta S = .879 - .719 = .16$

$T = 13,061.5$ gpd/ft

.879

.719

DRAWDOWN IN FEET

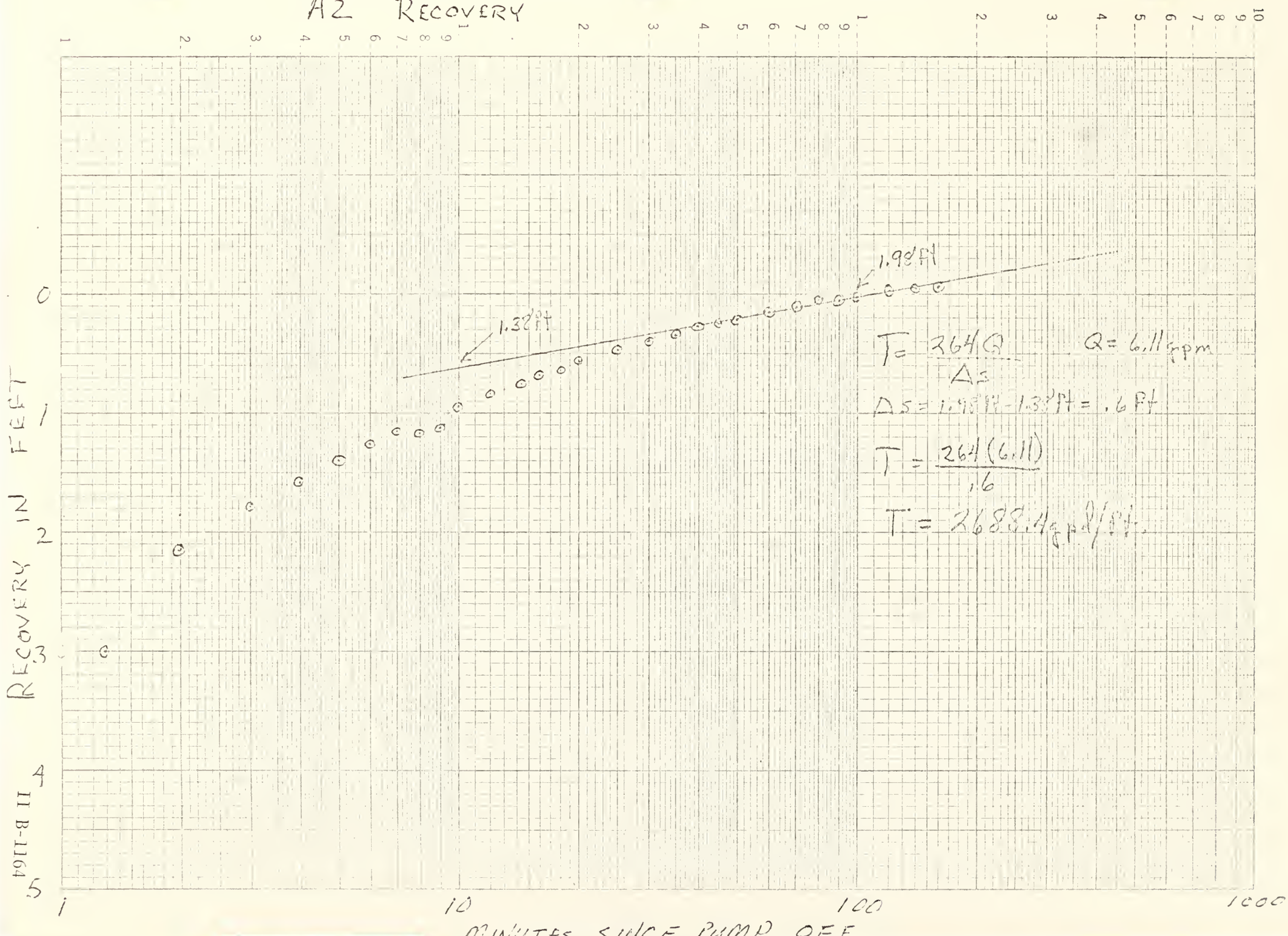
0.9
0.8
0.7
0.6
0.5
0.4

1
10
100
1000

II B-1163

46 5493

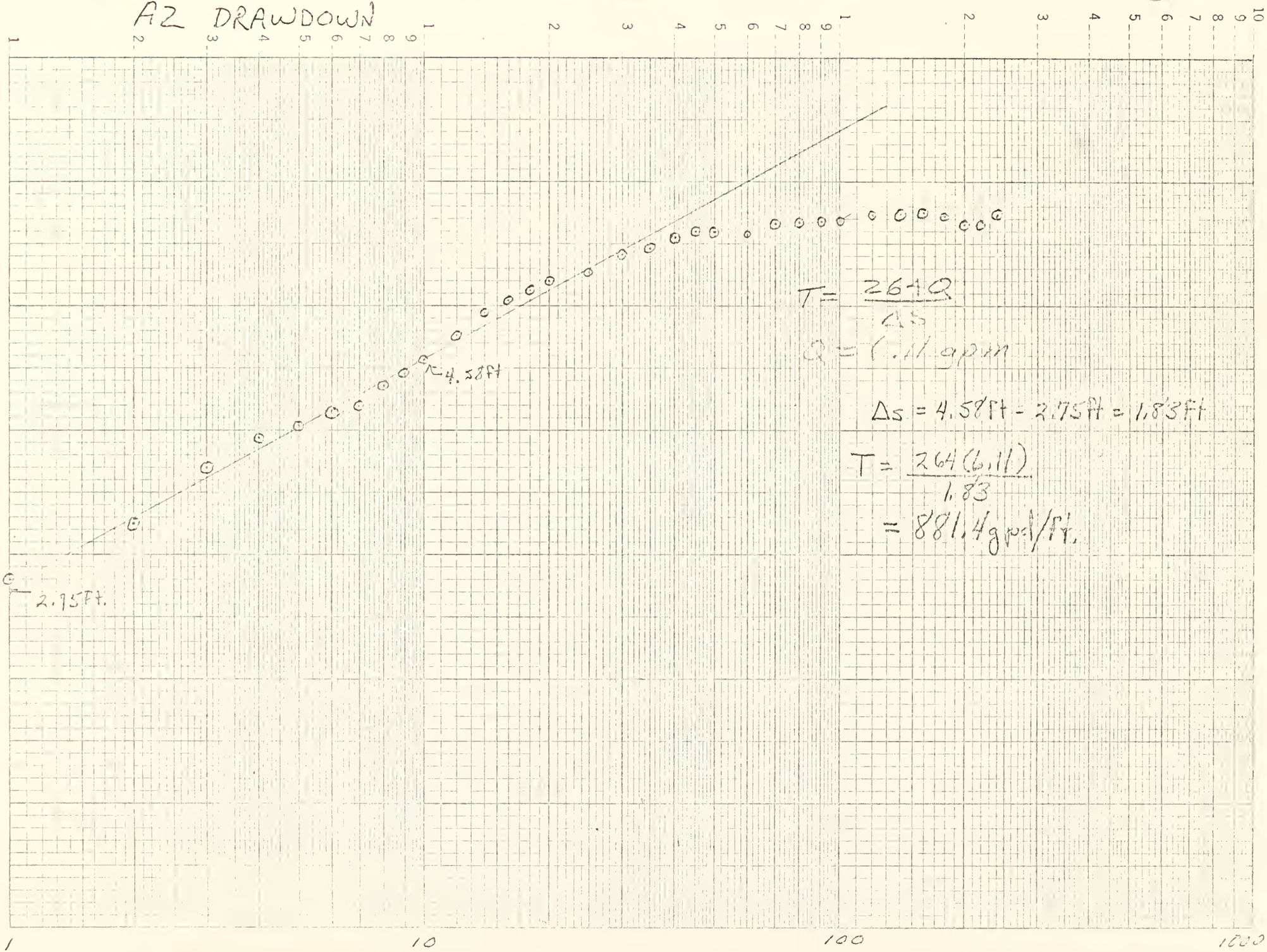
A2 RECOVERY



II B-1164

46 5493

A2 DRAWDOWN



$$T = \frac{264Q}{\Delta s}$$

$Q = 6.11$ gpm

$\Delta s = 4.58\text{ft} - 2.75\text{ft} = 1.83\text{ft}$

$$T = \frac{264(6.11)}{1.83}$$

$= 881.4$ gpd/ft.

J. Mahio

A-1

DATE: APRIL 23, 1975 STARTING TIMING: 11:29 A.M.

STATIC WATER LEVEL: 46.82 SAMPLE TAKEN: YES

DRAWDOWN (in feet)

IN	ΔH_2O LEVEL	TEMP.	CONDUCT	GPM	MIN	H_2O LEVEL	TEMP.	CONDUCT.	GPM
0	0.0				90	0.760			
1	0.59				100	0.762			
2	0.63				120	0.760			
3	0.675				140	0.760			
4	0.70				160	0.760	12.5	2200	6.11
5	0.705				180	0.750			
6	0.715				200				
7	0.730				220				
8	0.730				240				
9	0.730								
10	0.725								
12	0.735								
14	0.740								
16	0.745								
18	0.745								
20	0.745			6.11					
25	0.745								
30	0.750								
35	0.750								
40	0.755								
45	0.755			6.11					
50	0.755								
60	0.755								
70	0.760								
80	0.765								

RECOVERY (in feet)

MIN	ΔH_2O LEVEL	MIN.	ΔH_2O LEVEL
0	0		
1	.55	20	.76
2	.62	25	.76
3	.66	30	.76
4	.68	35	.76
5	.70	40	.765
6	.71	45	.77
7	.71	50	.77
8	.72	60	.77
9	.72	70	.77
10	.72.5	80	.77
12	.73	90	.77
14	.74	100	
16	.75	120	
18	.75	140	

J. Mathis

A 2

DATE: APRIL 14, 1975 STARTING TIMING 1305 HOURS

STATIC WATER LEVEL: 14.06' SAMPLE TAKEN: YES

DRAWDOWN (in feet)

IN	ΔH_2O LEVEL-in ft.	TEMP.	CONDUCT	GPM	MIN	H_2O LEVEL	TEMP.	CONDUCT.	GPM	
0	0				90	5.69	11.0	1300	6.11	55 gal/9 min.
1	2.8				100	5.69	11.0	1300	6.11	"
2	3.25				120	5.72	11.0	1300	6.11	"
3	3.7				140	5.74	11.5	1300	6.11	"
4	3.93				160	5.76	11.0	1300	6.11	"
5	4.03				180	5.72	10.5	1300	6.11	"
6	4.15				200	5.67	10.5	1300	6.11	"
7	4.29				220	5.67	10.5	1300	6.11	"
8	4.37				240	5.72				
9	4.47									
10	4.56									
12	4.77									
14	4.94									
16	5.09									
18	5.12									
20	5.20									
25	5.28	11.5	1250							
30	5.41			6.11						
35	5.47									
40	5.55	11.0	1300	6.11						
45	5.60									
50	5.60	11.0	1300	6.11						
60	5.58									
70	5.67	11.0	1300	6.11						
80	5.68	11.0	1300	6.11						

RECOVERY (in feet)

			ΔH_2O		ΔH_2O
MIN.	H_2O LEVEL	MIN.	LEVEL	MIN.	LEVEL
0	5.72	MIN.			
1.3	3.0	20	.58	160	−.07
2	2.15	25	.48	180	−.09
3	1.74	30	.40	200	−.10
4	1.59	35	.33	220	−.11
5	1.40	40	.28	240	−.12
6	1.27	45	.25		
7	1.16	50	.21		
8	1.18	60	.15		
9	1.12	70	.10		
10	.95	80	.05		
12	.83	90	.05		
14.5	.75	100	.01		
16	.69	120	−.03		
18	.63	140	−.05		

Lithologic Logs

II B-10 LITHOLOGIC LOGS

The lithologic logs present a description of rock types encountered in a core hole. The detail of description varies with depth and operation. In most cases, however, the lithology is described from drill cuttings on ten-foot intervals above the "A" groove. In the lower zones, the lithology is described from cores on one-foot intervals.

In addition to providing a means for describing lithology, the litholog presents data such as information on structural dip, joints, fractures, and general rock quality data. These data are entered in the lithologic log at the appropriate depth.

The final lithologic logs for the following wells are included in this section of the Third Quarterly Report:

AT-1a	SG-10
SG-1	SG-11
SG-6	SG-17
SG-8	SG-18
SG-9	SG-19

For information on lithologic logs compiled for other wells, refer to the Well Summary Table II B-1.

LOGS CONSIDERED SENSITIVE

ASK PERMISSION OF AOSS TO SEE LITH. LOGS